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THE EFFECT OF PEDAGOGICAL AGENT PERSONA
ON PERFORMANCE, SELF-EFFICACY, AND
ATTITUDES IN ADULT LEARNERS IN AN ONLINE ENVIRONMENT

A Dissertation
Presented to
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In Partial Fulfillment
Of the Requirements for the Degree
Doctor of Education

By
Justin L. Mathews

August 2021

THE EFFECT OF PEDAGOGICAL AGENT PERSONA
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When I chose educational research in online learning as my dissertation topic in Fall 2017, I had no idea just how salient the issue would become, and this process has taken many twists and turns over the intervening years. While this process often felt like an overwhelming and lonely experience when I was in the middle of it, I recognize that the reality was quite different. This work would not have been possible without the intellectual, moral, and financial support of many people and institutions.

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Pedagogical agents, virtual avatars that are often included in online training or educational modules, have been studied in a variety of disciplines to determine the extent to which their inclusion in online or multimedia learning environments may influence both cognitive and affective outcomes in learners. The present study examined the effect of a peer-like pedagogical agent providing motivational messaging in an online English language learning environment to determine if the agent will positively affect college students' performance, self-efficacy, and attitude in comparison to a control group. All participants studied an online, self-paced English grammar module, either with (treatment version) or without (control version) a peer-like motivating pedagogical agent. The study also sought to determine if learners would perceive the agent as having a distinct persona. The study found no statistically significant difference between the treatment group and the control group on performance, self-efficacy, and attitude. However, for both the treatment group and the control group, student performance and self-efficacy were significantly improved after the online English module. In addition, the participants perceived the agent as having a distinct persona.

CHAPTER I: INTRODUCTION

Statement of the Problem

One of the most important developments in higher education in the last two decades has been the vast increase in online and distance education courses which has occurred throughout the United States. For a variety of reasons, more and more students are turning to online education every year as either an alternative or as a supplement to face-to-face course offerings. Allen and Seamen (2018) reported that, as of 2016, the number of students participating in distance learning or online educational offerings has increased for each of the last fourteen years. Furthermore, the 5.6% increase in distance education students from 2015 to 2016 "exceeds the gains seen over the past three years," and the number of students studying on a physical campus declined by over 1 million students between 2012 and 2016 (p. x). At the same time, Muljana and Luo (2019) provided research showing that "the dropout numbers in online learning environments are reportedly higher than the traditional learning environment" (p. 21), and students in an online learning environment have unique challenges compared to those students in a more traditional educational setting. This can be particularly detrimental in a community college setting, where "high online attrition is likely to increasingly impact the degree completion rate of first-generation college students, low-income students, female students, and students of color" (Hachey et al., 2013, p. 4). These issues are particularly relevant as institutions of higher education throughout the country have been suddenly thrust into greater reliance on their distance learning offerings as a result of the coronavirus pandemic which closed schools throughout the country after March 2020. Heading into the Fall 2020 semester, many major universities such as Harvard, Rutgers, and the University of California announced their intentions to operate either fully or

mostly online for the coming semester, and this situation continued into the Spring 2021 semester. While this situation has proven extremely difficult for all stakeholders in higher education, it may also offer unique opportunities for educational leaders to experiment with new approaches to online learning design.

Educational Leadership Through Instructional Design

The relationship between educational leadership and instructional design may not be immediately obvious to most. In higher education, it is easy to think of teachers as the leaders of their classrooms, and it is apparent that the principal, president, or provost is a high-ranking leader for the institution. As Reiser and Dempsey (2012) noted, the field of instructional design can be thought of as an ill-defined and multi-faceted discipline without a universal definition. The authors did, however, arrive at a working definition of the field for the text, which says in part that instructional design "encompasses the analysis of learning and performance problems and the design, development, implementation, evaluation, and management of instructional and non-instructional resources intended to improve learning and performance in a variety of settings" (p. 5). This often involves the implementation of "instructional media to accomplish their goals (p. 5)." In this way, instructional designers are change leaders in institutional curriculum and in the improvement and implementation of technological and pedagogical innovation. Instructional designers can be called upon to collect and evaluate research data in order to make the best decisions possible for their institutions, but that leadership cannot stop at just collecting and evaluating data, particularly in an era in which technology and innovation are moving at such a fast pace. Educational leaders cannot just be consumers of knowledge; we must, rather, be producers of knowledge. By conducting research, educational leaders create opportunities to share their knowledge

and leadership with others and help lead others in the institution towards educational best practices. It provides a way to create data locally, and that data will help leaders make better instructional decisions and make the case for positive change to their followers. Instructional designers are uniquely situated to provide educational leadership in designing effective online programs through their knowledge of multimedia and innovative teaching strategies.

Given the increasing importance of online instruction at colleges and universities and the challenges the online environment sometimes poses, particularly for our most at-risk learners, it is even more important than ever for our educational leaders and practitioners to have a solid grasp of strategies and methodologies that will show the greatest improvements in learning outcomes for our online, hybrid, and distance learners. As such, it is necessary that leaders in higher education both be familiar with the most up-to-date ideas and technologies in the field and that they are also willing to actively participate in and contribute to the research in those areas. Educational leaders will then be able to use this knowledge and experience to help influence change within their own organizations that is based around theories of best practices that will improve the overall quality of their online course offerings. Being a part of this process helps the educational leader to more effectively implement and advocate for these strategies and technologies as he or she builds towards a coherent vision of what is possible to make the online classroom more unique and improve student learning outcomes in their programs. There is a wide array of educational technology and multimedia solutions that are now available to help educators more effectively facilitate learning in an online format. One such possibility is that the inclusion of animated pedagogical agents (APAs) could have a

positive impact on students learning in these environments, both in terms of cognitive and affective learning outcomes.

Animated Pedagogical Agents

Animated Pedagogical Agents (APAs) are informational or motivational virtual characters that are often present in online educational or training courses to facilitate and positively influence student learning, performance, and motivational outcomes (Choi & Clark, 2006; Craig et al., 2002; Gulz, 2004; Moreno, 2005). Moreno (2005) has traced the origins of modern pedagogical agents back to computer software agents. These software agents perform functions for the user and operate in the background but are not actually visible to users while they are operating the program, such as e-mail spam filters. Pedagogical agents, in contrast, do have their own visual appearance and persona, and some pedagogical agents are also given voices and the ability to make gestures and mimic body language. Pedagogical agents can help address some of the limitations of "conventional computer-based environments" because of "their ability to simulate social interaction" (Kim & Baylor, 2006, p. 570) and make connections with learners. These virtual characters can take many different forms and personas, and each of these various forms and personas can potentially have divergent effects on the learners with whom they are interacting. Lester et al. (1997) coined the term *persona effect* to describe the phenomenon of how social behaviors displayed by pedagogical agents can have a beneficial impact on both student engagement and motivational factors in multimedia educational environments. Haake and Gulz (2009) identified multiple pedagogical roles that agents could serve, and these roles were divided into two separate categories: agents that are more authoritative (the Tutor, the Guide, the Coach, etc.) and those agents that are less authoritative (the Co-Learner, the Learning Companion, the Peer Tutor, etc.).

These pedagogical roles can be thought of as mimicking directive or supportive leadership behaviors, respectively. More authoritative or directive leadership behaviors focus on providing specific instructions on completing a task and on outlining how a task is to be done and when it should be accomplished (Northouse, 2016, p. 117). There is little emphasis on making an emotional connection with the learner. Supportive leadership behaviors center around building relationships by being seen as "friendly and approachable," as well as making the work environment pleasant by treating followers as equals (p. 118).

Some of the literature involving pedagogical agents revolves around the three basic modes in which most pedagogical agents operate, namely the Expert, Peer, and Mentor styles. Baylor and Kim (2005) proposed these three functional roles for animated pedagogical agents, and the basis for the identification of these three personas goes back to Beishuizen et al. and others (2001) who demonstrated that both students and instructors judged human teachers to be effective based on factors like the extent of their experience and knowledge of the field and in their personality traits. This led to the assumption that effective computer-based agents could have a similar function in an online educational or training environment. Given the varying roles or personas that have been proposed for pedagogical agents, one question which arises involves the extent to which these different agent roles may produce different cognitive, affective, and motivational responses in the learner.

Expert Agent Persona

It may be said that the two pedagogical agent personas most frequently used in multimedia learning environments are the Expert agent and the Peer agent (Baylor & Kim, 2005; Kim, 2007; Liew et al., 2013), though some research has indicated that most

researchers have employed Expert or instructor-style agents rather than peer-like agents in their studies (Schroeder & Adesope, 2013b). This also tracks well with research that has shown leadership to consist of two basic behaviors: task behaviors and relationship behaviors (Northouse, p. 71). Task behaviors focus on the work that must be done to complete an objective without an emphasis on the affective side of working. Relationship behaviors, in contrast, do focus more on the affective concerns of the followers and places less emphasis on the task. The Expert agent is designed to meet the same social and psychological expectations a learner would expect from a human instructor who is an expert in their field. Baylor and Kim (2005) provided the pattern for how multimedia, computer-based Expert agents could be operationalized to meet those learner expectations, and the authors address each of the five points related to pedagogical agent design: image, animation, affect, script (i.e., the information being delivered), and voice. Cognitively speaking, the Expert agent must "exhibit mastery or extensive knowledge and perform better than the average within a domain" (p. 97), and the agent must demonstrate expertise far beyond that of the learner. In terms of on-screen presence, the Expert agent "will be confident and stable in performance and not swayed emotionally by instant internal or external stimulation (p. 97)," and he or she will exhibit only deictic gestures while speaking in a formal, professional, and authoritative way with no emotional engagement. Baylor and Kim's Expert agent is designed to look like a middle-aged or older professor who is in his or her forties and is in professional dress. Additionally, Liew et al. (2013) designed their Expert-like pedagogical agent following this same paradigm. The behavior and design of the Expert-like pedagogical agent would most closely imitate task-oriented behaviors.

Peer Agent Persona

At the opposite end of the spectrum from the Expert is the Peer agent. Baylor and Kim (2005) follow Bandura's (1997) ideas on social modeling by operationalizing this agent to be similar to the learner. They "attribute similarity between the learner and social model significantly affects the learners' self-efficacy belief" (p. 98), such that when the Peer agent is the same age as the learner, motivation and learning will improve. In this situation, Baylor and Kim operationalized the Peer agent to look like a male college student in his twenties to match those participants in their study. The Peer is dressed in a casual fashion, and he uses expressive body language and an enthusiastic voice and expressions to facilitate social connections with the learners. This social engagement is not limited to only positive interactions, for the agent can also experience and reflect a range of common learner emotions like frustration, annoyance, boredom, and happiness. The Peer-like agent is not nearly as knowledgeable as the Expert agent, but his willingness to learn and his interactions with the student drive the learner to increased motivation and learning. Liew et al. (2013) also follow this pattern for their Peer agent, though the gender of their agent is different. The Peer-like pedagogical agent would most closely align with relationship-oriented behaviors.

Need of Support for College Students' English Composition

Many studies have demonstrated the benefits of integrating pedagogical agents in teaching and learning, such as increases in learner performance, motivation, and self-efficacy, as well as exhibiting more positive attitudes toward a given subject area. These areas include STEM fields like mathematics (Arroyo et al., 2009, 2011; Kim, 2016; Plant et al., 2009) and engineering (Rosenberg-Kima et al., 2008, 2010; Plant et al., 2009). However, there is much less research available on the effect of animated pedagogical

agents in the Humanities, particularly when it comes to an examination of how APAs may be utilized to improve punctuation and syntax among native speakers of English in a university-level environment. Given that one or more general education courses in English composition are required at community colleges and universities across the United States—and many of these institutions are partially or wholly moving their instruction online for the duration of the coronavirus pandemic—it would be useful to examine the extent to which animated pedagogical agents can be effectively employed in an online learning environment for adults studying English. Having good written communication skills is a standard item on job postings in many different fields, and employers consistently say that they want applicants with these skills; however, O'Neill (2018) pointed out that research indicates few employers believe that new college graduates actually possess the ability to write well.

Though English is their first language, many native English speaking students often struggle with certain aspects of English syntax and grammatical rules, particularly when it comes to creating more complicated sentence structures. Composing compound sentences, for example, requires students to know the difference between an independent clause and a dependent clause so that they can avoid writing sentence fragments, and they must also be able to correctly punctuate the sentence without creating a run-on sentence or comma splice error. Kagan (1980) wrote that "the sentence fragment and the run-on sentence are among the most prevalent and irremediable errors found in grammatically deficient prose" (p. 127). It is possible that newly arrived university freshmen will not have received direct or explicit instruction in grammar and punctuation in the years before graduating high school. Despite this, college instructors would expect their

students to not make basic, sentence-level grammatical errors when they enter their classrooms. However, students make such errors in punctuation and syntax routinely, and many of them need some supplemental instruction in these areas, yet first year composition courses largely focus on the ability to write short, formal essays and the ability to read and respond to college-level writing rather than emphasizing sentence-level structural issues.

Research into the frequency of grammatical errors in college freshmen writing is relatively scant, particularly recently; however, there is some support in the literature that shows the extent of common errors in student writing. For example, Connors and Lunsford (1988) examined 3,000 student papers and found 2,466 errors in which students did not use a comma in a compound sentence (p. 403), while another 1,565 comma splices and 1,217 errors involving sentence fragments were found. An additional 681 run-on sentences were discovered. In a more recent study by Lastres-Lopez and Manalastas (2017), the researchers found that students at University College London committed many more errors in punctuation (50.3% of all errors) as they do in grammar (31.4%) or spelling (18.3%). Looking at punctuation errors specifically, the authors found that 38.7% of all punctuation errors involved omitting a comma, with an additional 9.1% adding a superfluous comma (p. 127).

As a required course in higher education, millions of students across the country pass through composition classes every semester, and a large number will take those courses in an online format, especially in the foreseeable future. Given the sheer volume of students who are currently enrolled in these courses and who will enroll in these courses in future semesters, it would be valuable to know if including a pedagogical

agent might be able to improve both cognitive (e.g., learning and transfer) and affective or motivational (e.g., self-efficacy and attitude) outcomes for students taking online courses. Currently, our knowledge of the effect of pedagogical agents on language learning is not well known and would benefit from this additional research. As a result, this study will focus on investigating the potential effectiveness of including animated pedagogical agents in an online learning environment for adult learners at a regional university in the southeastern United States.

Purpose of the Study

The primary purpose of the present study was to examine the effects of a peer-like, animated pedagogical agent on student performance, self-efficacy, and attitude among adult learners in an English composition module delivered in an online learning environment at a postsecondary institution. In addition, perceived agent persona was examined to understand learner perceptions of specific design features of the peer-like, animated pedagogical agent in the learning process. Including animated pedagogical agents in online and distance learning courses may be one tool educational leaders can employ to improve cognitive, affective, and motivational outcomes in the classroom.

Aligned with the purpose of the study, an experiment was conducted to compare two conditions on the intended learning outcomes: A Peer-agent experimental group and a control group with no agent present. In both conditions, learners were presented with punctuation and syntax rules involving the creation of compound sentences using conjunctive adverbs.

The *Peer-agent group* received motivational messages from a pedagogical agent designed to resemble a female college student in her late teens or early twenties. The

control group received text-only instructions related to the lesson and did not interact with a pedagogical agent.

With regard to the dependent variables, *performance* was measured by test scores on instruments that asked students to assess their prior knowledge of grammar concepts necessary to correctly form compound sentences with conjunctive adverbs, combine simple sentences to create a compound sentence using a conjunctive adverb, and compose their own compound sentences using conjunctive adverbs. Performance relates to student learning as measured by the post-test. *Self-efficacy* was measured by a 10-point rating scale which asked learners to self-report their confidence in performing specific skills related to the instruction they received throughout the module (Bandura, 2006). Self-efficacy here refers to the degree to which a participant believes that he or she is capable of learning the grammatical concepts being presented in the module. *Attitude* was measured by a 5-point Likert scale instrument (Olina et al., 2006), as well as open-response questions which asked students to further explain their feelings about the instruction they received. Attitude here refers to their motivation and perceptions of ease or difficulty surrounding the module and how that impacted their positive or negative feelings about the subject. *Perceived agent persona* was measured by a 5-point Likert scale (Ryu & Baylor, 2005), which asked learners to rate the agent persona features in terms of how they facilitated learning, appeared credible, appeared human-like, and were engaging.

Statement of Research Questions

The general question for this proposed study is: what are the effects of a peer-like, animated pedagogical agent on English writing instruction in an online environment?

The following questions are the specific inquiries that were made over the course of this study.

1. Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module impact student performance?

H_{1A}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student performance compared to the control condition.

H_{1B}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student performance between the pre-test and post-test for the treatment group. The control group without a peer-like, animated pedagogical agent in an online English composition module will not significantly improve student performance.

2. Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module improve student self-efficacy?

H_{2A}: A peer-like, animated pedagogical agent in an online English composition course will significantly improve student self-efficacy compared to the control condition.

H_{2B}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student self-efficacy comparing the pre-measure and post-measure for the treatment group. The control group without a peer-like, animated pedagogical agent in an online English composition module will not significantly improve student self-efficacy.

3. Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module affect student attitudes towards grammar instruction?

H₃: A peer-like, animated pedagogical agent in an online English composition course will significantly improve student attitudes compared to the control condition.

4. How do learners perceive the peer-like, animated pedagogical agent persona in an online English composition module?

Summary

Even before the coronavirus pandemic of 2020, the number of students enrolling in online education courses was increasing. The appearance of this pandemic has only emphasized the critical role of online learning in higher education, and as educational leaders, we have an obligation to study ways in which we can improve our courses and promote course design that has the greatest positive influence on student learning outcomes. It is possible that the use of animated pedagogical agents in the online classroom is one way in which this issue can be addressed.

Research has indicated that animated pedagogical agents, whether operationalized as an expert-like or peer-like agent, can have positive benefits for cognitive, affective and motivational outcomes for learners. While this research has been performed across disciplines, there has been less focus on empirical studies in the Humanities.

This study hopes to address that gap in the literature and seeks to investigate the relationship between the inclusion of a peer-like, animated pedagogical agent in an online English composition module. Based on prior research in the field, it is hypothesized that including this animated pedagogical agent will cause a statistically significant

improvement in student performance, self-efficacy, and attitude when compared with participants in a control condition. It is also hypothesized that there will be statistically significant improvements in the treatment group, but not the control group, when comparing the pre- and post- measures for performance and self-efficacy.

Chapter II will explore the recent literature in the field and will help to establish a theoretical framework for this study. Chapter III will describe the methods and instruments used in the study. Chapter IV will cover the results of the study, with Chapter V providing a discussion and interpretation of those results.

CHAPTER II: LITERATURE REVIEW

The purpose of this chapter is to present a review of the literature concerning the main issues related to the question of how pedagogical agent persona may influence English language learning in an online environment. First, there will be a brief review of key leadership and social psychological theories that will provide the necessary requisite conceptual and theoretical framework for this discussion. After that, research will be discussed that looks at the design of pedagogical agent roles, with a particular focus on peer-like agents, as well as a discussion of how pedagogical agent role has been shown to influence variables such as learning and self-efficacy. Finally, studies concerning how pedagogical agents have been utilized in language instruction will be reviewed.

Definition of Pedagogical Agents

As mentioned in Chapter I, the term “pedagogical agents” refers to intelligent or motivational virtual characters that are used in educational or training scenarios to help improve learner outcomes (Choi & Clark, 2006; Craig et al., 2002; Gulz, 2004; Moreno, 2005). Agents designed to be human-like in appearance interact with learners through verbal or text-based methods and have some or all of the following characteristics: facial expressions, hand gestures, eye movements, a human voice, and distinct personalities. In an educational setting, pedagogical agents are placed within a computer-based or online learning program to promote cognitive outcomes (e.g., learning or retention) or motivational outcomes (e.g., self-efficacy). Pedagogical agents can be utilized to provide scaffolding or support to help make learners aware of what they know and should learn in a given unit (Tien & Osman, 2010) or to improve learner motivation, behavior, and interest in the subject being studied (Maldonado & Nass, 2007). Both theoretical and

empirical evidence exists that may explain the potential benefits of including pedagogical agents in an educational environment.

Leadership Theories

There are some leadership theories which can be used to inform the design of the message delivered by the pedagogical agent. One such theory is the behavioral approach to leadership. Studies in behavioralism found that leader behavior could be categorized in two basic categories: task behaviors and relationship behaviors (Chemers, 1984). The Ohio State Studies described these behaviors as *initiating structure* behavior and *consideration* behavior, with the former acting as task behavior that organizes and structures the work to be done and the latter serving as relationship behavior that builds affective bonds between the leader and follower (Northouse, 2016). These two structures are not independent of one another, however, and they should not be thought of as occurring on a single continuum; leaders can have aspects of both (Hersey & Blanchard, 1979).

Situational leadership theory also provides a framework through which agent message design can be viewed. As the name suggests, this theory proposes that different situations or contexts require the leader to take different approaches and that there is not a one-size-fits-all approach to leadership (Northouse, 2016). Situational leadership theory suggests that, based upon the current level of the follower's development, the leader will apply different combinations of both task-oriented behaviors and relationship-oriented behaviors to produce a desired outcome (Hersey & Blanchard, 1995). The task-oriented behaviors exhibit more one-way communication techniques, such as providing clear and direct instructions on what task is to be performed and how to do it, while relationship-oriented behaviors involve more two-way communication structures like motivating and

encouraging others or involving others in the process (p. 209). As the learner's development level changes, so too will the combination of task-oriented and relationship-oriented approaches the leader applies.

Path-goal theory looks at how leader behaviors can impact a follower's satisfaction and motivation levels (Chemers, 1984). Leadership style or messaging should be directed towards the motivational needs of the followers to help them achieve their goals. The path-goal approach can be used with various leadership behaviors, including directive leadership and supportive leadership and suggests that different follower characteristics and task characteristics will require different leadership approaches (Northouse, 2016). For example, supportive leadership can work with unsatisfied followers performing simple and repetitive tasks, and directive leadership can be used with followers who need clear direction and who are performing complex tasks.

These theories could be used to impact the design of the messages delivered by a pedagogical agent depending on the educational context or situation. An educator may be able to write agent scripts that will use more task-based approaches when the learner's development level is at its lowest (e.g., early in the semester) and that will begin to apply greater amounts of relationship-based approaches to improve motivation or self-efficacy among learners. It may be possible that pedagogical agent message design can be tailored towards a specific learning outcome (e.g., cognitive, affective, or motivational).

Social-Psychological Theories

Social-cognitive theory is the theory which underlies this discussion of pedagogical agent design because various social psychologists have theorized that there is an inherently social component to learning which can influence learner outcomes. For example, Bandura (1977) theorized that social learning and psychological modeling can

happen when learners observe behaviors and interact with others, thus leading to greater self-efficacy. When a learner sees that another person has successfully been able to complete a task that he or she is being asked to do, the learner has an increased sense that he or she will be able to perform that task as well. This theory sought to explain how humans behave according to the interplay of three factors: cognitive, behavioral, and environmental. Later, Bandura (1997) refined his ideas to say that model-target similarity enhances the ability of the model (like an agent) to influence the target (the learner). Furthermore, according to Kim and Baylor (2006), Piaget (1995) found that "social interaction with equally able peers fosters cognitive restructuring and promotes cognitive growth" (p. 572). In addition, some research has shown that learners will treat pedagogical agents in the same way they treat human agents, indicating that there is a social component to interacting with and learning from a computer-based environment (Norman, 1997; Veletsianos & Miller, 2008).

Beyond social-cognitive theory, there are other ways of thinking about how sociology and psychology may influence the ways in which a learner could interact with a pedagogical agent. Similarity-attraction hypothesis, for example, theorizes that people are inherently drawn to those who are like them, a fact which influences how one behaves and interacts with others (Kim, 2016). This hypothesis can be extended even to computer-based learning, to the extent that "in a computing application the mere physical similarity between a user and the avatar induced the user's self-disclosure to a greater extent and led the user to perceive that they shared similar values, beliefs, and attitudes" (p. 61). This may suggest that learners will be more positively inclined towards an agent that is similar to them; however, this area has not been as deeply explored as some other

areas, and what information is available is mixed. For instance, Moreno and Flowerday (2006) hypothesized that learners would prefer to learn with an agent similar to them and that they would score higher on learning and affective measures than would those learning with an agent of differing gender and ethnicity. Their results, however, only showed support for learning with an agent of similar ethnicity among students of color. Ozogul et al. (2013) found that female middle school students gave higher program ratings when learning with a pedagogical agent of the same gender, but male students gave higher program ratings when matched with an agent of different gender. On the other hand, there is research that suggests "models of the same ethnicity seem to be viewed as more credible and to instill stronger efficacy beliefs and behavioral intentions than models of other ethnicities" (Kim & Baylor, 2006, p. 586) and that agent ethnicity does play a role in learner outcomes (Baylor & Kim, 2004). Also, in their study of female self-efficacy and self-esteem in the STEM subjects, Rosenberg-Kima et al. (2008) found that learners were influenced both by agents seen as young and "cool" and by agents perceived as older and "un-cool." Similarly, Veletsianos (2010) noted that learners consistently rated his artist agent higher than his scientist agent and theorized that this "could be viewed with a Similarity Attraction Hypothesis lens" (p. 25). These results are suggestive but far from conclusive, and while the similarity-attraction hypothesis is a reasonable and attractive lens through which to explore the effect of pedagogical agents, it needs more research.

Social psychology has also theorized that the mere presence of an audience will aid someone in performing a task and that people can actually perform better and find positive motivational benefits when they are in the presence of others and are "more

aware of social evaluation" (Hayashi, 2012, p. 23). These theories would suggest that educators can design pedagogical agents in such a way that they not only visually simulate a human agent but that simulates actual human interactions with learners in a computer-based environment with the potential to improve learning or affective outcomes.

Pedagogical Agent Design

There are multiple ways in which researchers have sought to analyze pedagogical agents and their potential effects on learners. The present study approached this issue from a perspective of pedagogical agent roles and their physical attributes in the learning environment and its impact on student cognitive and affective outcomes, particularly performance, self-efficacy, and attitude.

Pedagogical agent roles can operate at various points on a spectrum from more authoritative roles to less authoritative roles. Baylor and the Pedagogical Agent Learning Systems (PALS) Research Group (2003) examined how pedagogical agent roles influenced learning and motivational outcomes by comparing these roles in three areas: agents that operated with and without motivation, with and without expertise, and with both motivation and expertise. These agent roles were then delineated around three major instructional roles that agents play in learning: Motivator/Peer, Expert, or Mentor. In this framework, the Motivator/Peer was designed to promote motivation and support for the learner, the Expert was designed to deliver information, and the Mentor provided both information and motivational support. By comparing these roles, the researchers hoped to learn how agent roles differ in their abilities to demonstrate learner improvements in areas like motivation and learning. They found that agents with motivation (Motivator/Peer and Mentor) were seen as more human-like and better

facilitators of learning, but they were also deemed less credible. Agents with expertise (Expert and Mentor) were shown to be more credible and promote better learning transfer, but they were seen as less supportive. The researchers concluded that "encouragement alone is not sufficient...for learning transfer" and that it is important "to have both expertise *and* motivation in support of learning" (p. 929).

Baylor and Kim (2003) delineated five separate design aspects that would be used to give their multimedia agent human-like characteristics: image, animation, affect, script, and voice. They noted that it is the combination of these factors which make a pedagogical agent's role believable, and if one or more of these factors do not match, the effectiveness and credibility of the agent will be compromised. The image refers to the visual appearance of the agent in terms of age, dress, and style, while animation describes any movements that the agent undertakes during the program (hand gestures, eyebrow raises, smiles, head nods, facial expressions, etc.). Affect relates to the emotions expressed by the agent in the course of the program, which helps the learner connect to the students on a social level. Script is the actual dialogue the agent delivers, which is designed to mirror the way in which a particular agent persona (Expert, Peer/Motivator, Mentor) would speak. Voice is the tone which the agent utilizes, and it is designed in such a way as to approximate the tone that a human agent with a particular persona would use. In addition, Baylor and Kim (2005) proposed that agents could be designed in such a way that the agents would elicit in the learners the same kind of social and psychological reactions that learners experience when they learn from a human expert. In order to more fully understand the differences between these agent roles and to see how

each role is influenced by these five design aspects, it is necessary to examine each part a bit more fully.

Image

Agent image, which refers to how the agent is presented visually on screen, is one area in which Expert and Peer agents can be differentiated. In order to successfully be perceived as having either an Expert or Peer role, the pedagogical agent must be designed according to the same visual cues that learners recognize when dealing with humans who exhibit Expert or Peer traits. For example, Baylor and Kim (2005) portrayed the Expert agent as a middle-aged male who is well-dressed and appears as a college professor. Liew et al. (2013) also followed this pattern, showing their Expert agent as a female college professor in her forties. In terms of the Peer agent, Baylor and Kim (2005) portrayed a younger male who is casually dressed and looks like a student, and Liew et al. (2013) designed their Peer as a female college student in her 20s. Veletsianos (2010) utilized hair style and color to differentiate his Expert agent (a scientist) from his Peer agent (an artist). Rosenberg-Kima et al. (2008) operationalized their peer-like agent as being in their mid-20s.

Animation

Animation refers to how the agent presents information or garners student interest and attention through gestures. Agents in the Peer or Motivator role utilize a range of enthusiastic or expressive gestures as they deliver their content, while the Expert role only uses deictic gestures, such as pointing to items on screen (Baylor & Kim, 2005; Haake & Gulz, 2009).

Affect

Affect is another key indicator of the role exhibited by the agent and of the relationship between the agent and the learner. Peer or Motivator agents can express a range of emotions in their role, whereas an Expert agent exhibits no emotional expressions (Baylor & Kim, 2005). This is similar to Haake and Gulz's (2009) design, for their Expert agent is designed to have no affect. The Peer agent, however, expresses a range of feelings, such as confusion, disapproval, and surprise.

Script

One of the major design features used to differentiate between pedagogical agent roles is the script used by the agent. Agent scripts can feature either expert modeling or peer modeling, and it is this difference in delivery of content knowledge that is a key delineator between Expert agents and Peer or Motivator agents. Research has found that a learner's self-efficacy beliefs are partially dependent on how similar in competence they perceive themselves to be to the model and on the extent to which the model succeeds in completing the action they are performing (Schunk et al., 1987). An Expert agent is designed to be more authoritative than the Peer agent, and when the Expert delivers content knowledge, they have a knowledge base that is far beyond that of the learner (Baylor & Kim, 2005). The Expert delivers the knowledge without error and exhibits confidence from the beginning of the lesson. A Peer agent, in contrast, does not have the same extent of knowledge exhibited by the Expert, making the Peer more similar to the learners. Scripts for the Peer or Motivator agent is primarily about encouragement, while that of the Expert is mainly directed towards information (Haake & Gulz, 2009).

Voice

Agent voice also plays a key role in helping identify the role of the agent. The Expert agent is designed to present information in an authoritative, professional way and relies on formal, standard speech patterns (Baylor & Kim, 2005). The Peer agent is more demonstrative in its voice, and it has the ability to be exuberant or enthusiastic in its delivery. In Haake and Gulz's (2009) study, their Peer or Motivator agent contained voice attributes that included "greater warmth and expressiveness, reinforcing interjections and more variation in pitch, amplitude, duration, and tempo" (p. 13) than their Expert agent.

Reported Benefits of Pedagogical Agents

It has been theorized that the inclusion of animated pedagogical agents in multimedia learning environments has a positive influence on various cognitive and affective outcomes. The following section will discuss some of those benefits in the areas of student performance, self-efficacy, and attitude – the intended learning outcomes of the present study.

Performance

According to the *persona effect*, simply having an animated pedagogical agent be present in the learning environment has the ability to positively influence the learner's experience (Lester et al., 1997). At the same time, research is mixed as to the extent to which the inclusion of an animated pedagogical agent fosters increased learning. For example, Choi and Clark (2005) have argued that even if learners report greater positive perceptions from working with a pedagogical agent, students do not necessarily learn better because of it. However, in their study of Chinese university students, Lin et al. (2020) found that an agent using a conversational style showed improvements in learner

retention, though they also noted that this did not extend to improving transfer. There have been other studies which have shown improvements in student performance as a result of working with pedagogical agents (Atkinson, 2002; Haake & Gulz, 2009; van der Meij, 2013).

Furthermore, Schroeder et al. (2013) conducted a meta-analysis of 43 studies which indicated that the effect on performance from learning with pedagogical agents was small yet statistically significant (p. 13). In addition, this analysis looked at how the effect of pedagogical agents on learning performance differed based on subject domain. For example, their analysis found that studies examining learners using pedagogical agents in the math (n=8) and science (n=19) fields exhibited performance outcomes that were statistically significant and had large effect sizes. Conversely, those studies looking at learner performance in the humanities (n=16) did not yield significant results (e.g., Choi & Clark, 2006). This is important for the present study because the present study will be examining subjects learning in a humanities setting.

One of the studies in Schroeder et al.'s analysis dealt with agent messages. As part of his dissertation, Park (2006) examined the role that seductive messages, which can be "defined as script that is interesting but irrelevant to learning contents" (p. 38), played in learner achievement. One source of seductive messages in this study was from a pedagogical agent playing a companion role, and agent role was operationalized according to image, voice, animation, and affect. The companion, "Mike," was friendly, youthful looking, and used expressive facial expressions. The study also featured an agent in an instructor role named "Dr. Handricks," who was straight-forward, older, and used little animation. Park found that seductive messages given by a pedagogical agent

had no significant impact on learner achievement, which he explained by pointing to previous research showing that interesting but irrelevant information "either reduces or doesn't facilitate students' remembering of the main idea" (p. 85). In addition, the author found no difference between the companion and instructor role in terms of achievement, attitude, or learning interest, which he attributed to the possibility that learners did not recognize differences in the agents' personas. Park did find, however, that seductive messages delivered by pedagogical agents did significantly impact learning interest.

Self-Efficacy

Learner self-efficacy is an important factor in learner academic success. How an individual perceives their own self-efficacy is determined "through their actual performance, vicarious (observational) experiences, forms of persuasion (e.g., 'You can do this'), and physiological indexes" (Schunk et al., 1987, p. 54). Closely related to this concept is the idea of learner mindset. Dweck (2006) described a fixed mindset—a frame of mind in which one believes that intellectual capacity is set at birth and does not vary—and a growth mindset—a frame of mind which believes that human intelligence can be improved upon through effort and hard work. Yeager and Dweck (2012) further showed evidence that learner resilience in the face of academic problems can be strengthened "through brief but powerful interventions to change students' interpretations" of those problems (p. 312). In theory, then, a Peer pedagogical agent can be developed with motivational messaging to encourage learners towards a growth mindset, which would positively impact their self-efficacy beliefs.

Indeed, some studies of pedagogical agent roles have shown that Peer agents or agents which exhibit motivational messages positively impact learner self-efficacy

beliefs. Baylor et al. (2004), for example, found that self-efficacy was considerably increased after working with an animated pedagogical agent who utilized motivating messages in a math setting. Also, Baylor and Kim (2005) found that a Motivator agent led to increased self-efficacy among learners. In addition, Van der Meij (2013) found that learners working with a pedagogical agent who used motivational messages made more substantial gains in self-efficacy than those learners in the control condition.

Huang and Mayer's study (2016) looked at a particular type of motivational messaging to examine techniques that can be used to reduce learner mathematical anxiety in a computer-based learning environment. An online pedagogical agent utilized a coping message to help college learners reduce and manage their anxious feelings during the treatment. The messages focused on helping students acknowledge and accept the anxiety they were feeling and encouraging them to actively cope with that anxiety. The study found that the treatment group achieved higher accuracy on the practice problems and showed a slight increase in self-efficacy at the end of the module. Qualitative analysis of the data indicated that, for those who found them helpful, the agent coping messages worked because the messages were encouraging and provided clear information on what to do. For those learners who did not find the messages helpful, they reported that their anxiety was already low or that they already knew the information the agent was presenting. In addition, both Huang and Mayer (2019) and Huang et al. (2020) demonstrated that agent-delivered motivational messages, including a growth mindset-based coping message (e.g., "Your ability in solving the problems will grow with your continuous effort") and effort feedback to student practice (e.g., "Terrific. Good effort solving the problem!"), were essential components of a set of four strategies to improve

college students' performance and self-efficacy while reducing their learning anxiety in an online mathematical learning environment.

Karumbaiah et al. (2017) specifically examined the effect of a virtual tutor who utilized various types of affective messages on sixth-grade math students. In this study, the researcher examined learning companions in an online math lab who provided empathy, growth mindset, and success/failure messages. Examples of growth mindset messages in the study include, "Hey, congratulations! Your effort paid off, you got it right!" and "Did you know that when we practice to learn new math skills our brain grows and gets stronger?" Learner responses to growth mindset messages in this study were mixed. While the authors found students receiving these messages tended to solve more problems correctly during their first attempt, these students also tended to make more mistakes. The authors note, however, that because "growth mindset messages emphasize that making mistakes is okay and can even help learning" (p. 101), the high number of errors is a positive development. Less encouragingly, the authors also found that these learners did not do as well on the post-test. They attributed this to the idea that higher-achieving math students would have "rejected growth mindset messages" that may have seemed "unnecessary" to them.

Fountoukidou et al. (2019) proposed that a pedagogical agent's instructional method would play a key role in both affective and cognitive outcomes. They conducted two studies in which they examined the effectiveness of a pedagogical agent who exhibited behavioral modeling and compared this to a no-agent condition. The authors noted that they designed the appearance of their agent based on previous literature and

chose to match the agent to their learners: young (about 25 years old), attractive, and "cool." Learners in the agent condition showed a significant increase in self-efficacy.

Attitude

The *persona effect* also applies to student attitudes towards the subject domain they are studying. Some studies have shown that pedagogical agents can be designed in such a way as to have a positive influence on learner attitude, interest, and motivation (Baylor & Kim, 2005; Lin et al., 2020). Kim (2016), for example, conducted an experiment involving 67 female students in a ninth grade algebra class, and this study explicitly compared an Expert agent (designed as a forty-year-old teacher) with a Peer agent (designed as a 15-year-old student). The study found that girls who worked with a male peer-agent showed more positive attitudes towards mathematics, while simultaneously finding that girls showed improved attitudes towards mathematics while working with an Expert female teacher compared to a female peer (p. 67). This may be a result of the female students seeing the teacher as a role model figure.

Research has also indicated that pedagogical agents can improve affective outcomes in science areas, particularly in the fields of engineering and mathematics, though some of these studies are gender-specific. Rosenberg-Kima et al. (2008), for instance, conducted a pair of experiments to examine the influence of pedagogical agents on female students in engineer-related fields. Their experiment set up a contrast based on agents displaying three factors: gender (male/female), age (younger being approximately 25 years old, older being approximately 45 years old), and "coolness" (as determined by clothes and hair style). The researchers' assumption was that a young, "cool," Peer-like female agent would "be the most persuasive and have the most positive impact on

stereotypes, attitudes, and self-efficacy of the young women," whereas a male Expert agent who "looks like a stereotypical engineer" would be more effective "in influencing beliefs about the utility of engineering" as a profession (p. 2,750). The study involved 111 female undergraduates in an introductory educational technology course and utilized eight separate agents. As predicted, the Peer-like female agent had a positive impact on stereotypes of engineers, and the male agent increased students' beliefs about the usefulness of engineering. Rosenberg-Kima et al. (2010) conducted a follow-up study which examined five dependent variables: self-efficacy, interest, usefulness, gender stereotypes, and engineering stereotypes. This study did support the idea that pedagogical agents can positively influence gains in all five dependent variables under study.

Plant et al. (2009) conducted a study of 106 middle school students in the United States to test affective outcomes in the field of engineering, and the experiment employed agents designed to be approximately 25 years old, attractive, and "cool" (though the authors did not use the term Peer agent or Motivator agent). The study found there was an influence on decreasing gender stereotypes related to engineering, and in some agent conditions, there was an increase in the number of learners who expressed a positive attitude towards math and science, as well as causing the learners to show a greater interest in pursuing a career in an engineering-related field.

In the mathematics field, Arroyo et al. (2009) examined attitudes towards mathematics attitudes using a Peer-like tutor. In this article, the researchers described two separate studies they conducted, one related to the high school math students (n=38 divided evenly between male and female) and the other related to female undergraduate

university students (n=29). The study of high school students did include a control group, and the research found that students in the experimental group did demonstrate increases in learning and motivation, but these gains were not significantly higher than the control group. In the second study, female university students working with a male agent performed better on items measuring learning, motivation, and attitudes toward mathematics.

In a study of seventy-two freshmen in a computer-programming class conducted at a private Asian university, Liew et al. (2017) found that a pedagogical agent exhibiting enthusiasm (operationalized via enthusiastic tone, constant smiling, and considerable head movements) fostered greater positive emotion, cognitive outcomes, and intrinsic motivation in learners than an agent designed to be neutral (operationalized via a calm voice, neutral expression, and few gestures). It was suggested that an agent who displayed enthusiasm for the subject matter had the effect of creating enthusiasm in the learner as well, which promoted the gains in positive affect seen in the study. That motivation and cognitive outcomes also increased was attributed to the verbal and non-verbal cues of the agent and the increased level of effort seen in those learners working with an enthusiastic agent.

The ability of a pedagogical agent to impact student attitude may be as great as that of a human instructor. For example, Horovitz and Mayer (2021) described how the positivity principle indicates that students are able to pick up on the emotional state of their instructor, which in turn has an impact on the learner's own mental state and cognitive outcomes. They found that, while learners were better able to detect emotions in a human instructor than a pedagogical agent, both the human instructor and the

pedagogical agent had a similar effect on the emotions of the learners (e.g., an instructor who appeared bored had students who reported feeling bored). This would suggest that the attitude and emotion displayed by the pedagogical agent could potentially have the same effect on the learner.

Pedagogical Agents in Language Instruction

While there has been a considerable amount of research on pedagogical agents in the STEM (Science, Technology, Engineering, and Mathematics) and education fields, much less has been written on the impact of pedagogical agents in language learning. Much of the research that has been conducted has centered on second language acquisition.

To this point, studies that have been conducted on language learning have not produced much support on the efficacy of using pedagogical agents in language instruction. Choi and Clark (2006), for example, focused on English as a Second Language students learning relative clauses, and their study featured an experimental group with an agent designed as a male genie who gave verbal instructions and pointed towards items on the screen. This was in comparison to a control group which utilized an arrow and voice to give students explicit direction. The spoken text in both groups was said to be in conversational style. This study involved 94 students enrolled in a university ESL program, and their results did not produce a statistically significant effect on performance test scores, interest, or motivation between the treatment and control groups. At the same time, learners with less prior knowledge did learn more efficiently with the pedagogical agent than in the control group, a fact which the authors suggested could be a result of learner interest in the agent leading to deeper learning or that the task

could have felt less difficult in the agent group. The authors proposed that the instructional method is more influential in learning than the delivery method.

Theodoridou (2011) used 47 American students studying Spanish to see if a pedagogical agent could produce positive results in second language retention and lexical retention. The study also sought to examine student attitudes and reactions to learning Spanish vocabulary in a web-based environment. The pedagogical agent was named Laura, and her role was to greet students and give them directions upon entry to the learning site. In addition, the agent was physically present in the instruction, and she would deliver content when the "play" button was pressed. Laura's voice was the audio for both groups, but her image only appeared in the experimental group. Neither of the author's two hypotheses were supported: there were no significant differences between the experimental group and the control group in the vocabulary learning outcomes, and the experimental group did not express significantly more positive reactions to learning Spanish vocabulary. Theodoridou suggested that since the definitions and example sentences that Laura gave were also available in text and audio, the agent's presence did not produce any additional assistance to the learner. At the same time, the author reported that in the qualitative data, learners reported feeling very positively towards the agent, though a couple of learners mentioned that Laura "was too animated" (p. 349) and became distracting.

Ko's (2010) dissertation study was also unable to find any significant support for the utility of pedagogical agents to positively influence language acquisition. Her study took place in an English as a Foreign Language (EFL) environment and focused the extent to which the inclusion of pedagogical agents would impact listening anxiety and

comprehension among mostly (94%) freshman students at a private university in Seoul (n = 66). The learners in her study were randomly assigned to one of three conditions: no agent, a Korean agent, or an American agent. Both agents were designed to look like college age females, and female students were used to record both agents' voices. Ko did not find any statistical difference in regards to either listening anxiety or listening comprehension between the experimental group and the control group. At the same time, though, student comments about working with the agent did show support for the belief that learners can become engaged on a social level with the agent, suggesting that some positive benefits are still possible with pedagogical agents. Also, Ko found that students in both conditions had similar reactions to the experience and reported that they enjoyed the program, meaning that listening anxiety and comprehension might have been equally affected regardless of the condition in which the learner was placed.

Conclusion

While there are an abundance of studies on pedagogical agents, it cannot be said that there is conclusive agreement on the benefits of using pedagogical agents in a web-based environment. Some studies support the idea that there are statistically significant differences between agent and no-agent conditions, while other studies have not produced similar evidence. Part of the difficulty of generalizing from the available information is that these pedagogical agents are being used in different fields and operationalized in a variety of ways. Furthermore, there is relatively limited research on the effect of agent roles and on the effect of using pedagogical agents in the humanities. No studies were found that examined agent role in a university English class, and that is a gap in the literature that this research study aims to explore.

Finally, an important factor to remember is that many of these studies of pedagogical agents do not include a control group; instead, they focus on comparing two or more different agent personas and designs. Without control groups present in the study, it is more difficult to assess whether or not pedagogical agents actually do impact performance, self-efficacy, and attitude and to determine in which areas they would be most effective.

This study was put forward as an attempt to contribute to the literature surrounding pedagogical agents by addressing some of the gaps seen in the current literature surrounding the use of pedagogical agents in an online English grammar module. The desire is to produce a study with both a control group and a treatment group that examines domestic college-level learners studying English with a pedagogical agent. This study aims to examine whether a peer-like, animated agent delivering motivational messages can have a positive influence on learner performance, self-efficacy, and attitude.

CHAPTER III: METHOD

Introduction

The purpose of this study was to explore how the inclusion of an animated pedagogical agent may impact student performance, self-efficacy, and attitude in an online English learning environment in comparison to an instructional environment that does not employ an animated pedagogical agent. Specifically, the study looked at the inclusion of a peer-like pedagogical agent in a lesson based on creating compound sentences with conjunctive adverbs. The design of this study was experimental with both a pre-test and post-test, and it consisted of two conditions: A Peer-like Agent group and a control group with no pedagogical agent. The pretest was used to determine the equivalency of the two groups prior to the experiment. The posttest was used to compare students' scores between the two groups in order to determine the extent to which the inclusion of an animated pedagogical agent in the online module impacted student performance (Research Question 1). A gain score analysis was also conducted to examine the improvement in test scores from the pre-test to the post-test to find out if the rate of improvement was similar or different for each group (Research Question 1). In addition, quantitative and qualitative survey measures were used to determine if the inclusion of an animated pedagogical agent improved student self-efficacy (Research Question 2), and affected student attitudes towards grammar instruction (Research Question 3). Furthermore, students in the experimental group were surveyed about their reactions to their agent to better understand the role of the agent in their learning process (Research Question 4).

Participants

The raw data were collected from a total of 78 students enrolled in undergraduate-level courses at a four-year higher education institution in the southeastern United States. These participants were assigned to one of two groups, a treatment group and a control group. When participants responded to the e-mail asking for students to complete the experiment, they were given a list of days and times and were asked to choose which day and time they wished to participate. Participants were assigned to a group based on the day on which they completed the experiment (e.g., participants who signed up to participate on Tuesday were placed in the control group, participants who signed up on Wednesday were placed in the treatment group, etc). Of those, 43 participants were placed in the treatment group, and 35 participants were in the control group.

Two rounds of data cleaning were conducted to ensure that only those eligible to complete the survey were included in the final analysis. In the first round of data cleaning, three students were removed because they did not meet the participation criterion of the study (undergraduate students who were 18 years old or above). In addition, eight students who scored over 90% on the pre-test were excluded from the analysis as a result of their high level of prior content knowledge. Two students were excluded because they did not complete the pre-test portion of the study, and two other students were removed because they missed the attention check question embedded in the online module. Finally, one student was excluded because of a technical error that caused the online program not to open correctly on her computer.

Upon completion of the first data cleaning, a second cleaning was conducted in which an additional 20 participants were removed because an error in the set up of the self-efficacy and attitude surveys made it impossible to identify which participants

recorded which responses on those items. More specifically, the demographic survey, pre-self-efficacy survey, the post-self-efficacy survey, and the attitude survey had been entered into Blackboard as anonymous surveys, meaning that it was impossible to link those individual participants to specific demographic and self-efficacy questions. Because of this, these participants' responses were not included in the final results of the study.

As a result, at the end of the second round of data cleaning, a total of 42 participants were included in the analysis of the results, of which 21 were in the control group, and 21 were in the treatment group.

A demographic questionnaire (see Appendix A) was used to record information about each student's age, gender, ethnicity, employment status, and English background. In addition, information was collected about the participants' educational experience, such as the number of years in college, what type of institution they attended, their current major, and whether or not they had previously taken a fully online course.

Participants ranged in age from 18 to 47 years old with a mean age of 22.17 ($SD = 5.897$). There was large disparity among the participant sample along gender lines, with 71.43% being female ($n = 30$) and 26.20% being male ($n = 11$). One student self-reported as being non-binary. Two respondents (4.76%) reported that English was not their native language. The sample consisted of thirty-three White students (78.57%), three Hispanic students (7.14%), three Black students (7.14%), and two students who identified as Other (4.76%). One participant reported mixed ethnicity.

Table 1 summarizes the participant information by condition.

Table 1*Demographic Information of the Participants by Condition*

Characteristics	Description	Number		Percentage	
		Control	Treatment	Control	Treatment
Gender	Male	6	5	28.57%	23.81%
	Female	14	16	66.67%	76.19%
	Non-Binary	1	0	4.35%	0.00%
Age	18-21	13	17	61.90%	80.95%
	22-25	6	1	28.57%	4.76%
	26-30	0	1	0.00%	4.76%
	35-40	1	2	4.76%	9.52%
	Over 40	1	0	4.76%	0.00%
Ethnicity	White	16	17	76.19%	80.95%
	Black	3	0	14.29%	0.00%
	Hispanic/Latino	2	1	9.52%	4.76%
	Mixed	0	1	0.00%	4.76%
	Others	0	2	0.00%	9.52%
Native Language	English	19	21	90.48%	100.00%
	Spanish	2	0	9.52%	0.00%

Study Materials**Instructional Modules**

The instructional materials used in this study consisted of two versions—a treatment version and a control version—of a multimedia module on learning the function and use of conjunctive adverbs. The computer-based module was developed by the researcher in Adobe Captivate 9 and was distributed to participants via the Blackboard Learning Management System. The Peer Agent for the experimental condition was developed using the AR Emoji Camera app in a Samsung Note10 Plus cellular phone.

Students who participated in this study were intended to learn grammatical rules dealing with the correct punctuation of sentences using conjunctive adverbs. For this, students were supposed to learn rules about combining independent clauses using the

correct conjunctive adverb, a semicolon, and a comma. When combining two independent clauses to form a compound sentence, it is necessary to put the conjunctive adverb between the two independent clauses, and the semicolon must come before conjunctive adverb, while the comma must come after the conjunctive adverb. The pattern is as follows:

Independent clause; + conjunctive adverb, + independent clause

The learning module consisted of materials the author had adapted for use in his higher education English classes, and the module was designed according to Robert Gagné's nine events of instruction (Gagné et al., 1992), a well-known instructional theory that guides the design of instruction. Gagné said that the conditions for learning are created by internal and external stimuli, with the internal stimuli being the prior knowledge, skills, and experience that learners bring with them to the classroom and external stimuli being the elements outside the person that promotes learning. In this framework, there are nine separate events that support the appropriate conditions for learning to occur:

1. Gain the learner's attention
2. Provide learning objectives
3. Stimulate recall of learner background knowledge
4. Present the lesson
5. Provide guidance to the learner
6. Elicit performance from the learner
7. Provide feedback on the learner's performance
8. Assess the learner's performance
9. Enhance retention and knowledge transfer

It was around this general structure that the online learning module was designed.

The learning content can be divided into four parts: (a) understanding the difference between an independent and dependent clause in standard English, (b) defining compound sentence and conjunctive adverb, (c) reviewing the rules for using conjunctive adverbs in compound sentences, and (d) creating compound sentences in practice exercises.

The first part was intended as a review of the prerequisite knowledge that learners should already have at this stage of their education (though they may not remember specific terminology). It described the difference between an independent clause and dependent clause and reminded participants what constituted a complete sentence, including one example of each to demonstrate the difference for the learner. Figure 3.1 is a screenshot of the example slide used in both conditions which was presented in the first part of the module. The example sentences used throughout the module were identical in both conditions.

Figure 3.1

Screenshot of an Example Slide of the First Part of the Module

For example:

Jennifer went to the store yesterday.
Subject *Verb*

This sentence contains a subject, a verb, and expresses a complete thought. It stands alone as a complete sentence and is an **independent clause**.

Now, consider the following:

When Jennifer went to the store yesterday
Subject *Verb*

While this sentence does contain a subject and a verb, it does not express a complete thought. What happened when Jennifer went to the store? We do not know from the information in this clause; it is dependent on an independent clause to provide us this information. Therefore, this is a **dependent clause**.

Now that you have reviewed dependent and independent clauses, let's look at our second objective: conjunctive adverbs.

Previous Next

The only difference between the control condition and the experimental condition in the first part of the study was the inclusion of the pedagogical agent, who delivered a motivational message to the participants but did not deliver content. In the experimental group, the agent appeared on-screen to deliver her motivational message after the introduction of the learning topic (see Figure 3.2) and was removed from the screen before the text appeared.

Figure 3.2

Screenshot of the Pedagogical Agent Delivering a Motivational Message in the Treatment Version of the Module



The motivational message the agent delivered is presented below. The message was developed based on empirical research showing that developing a growth mindset through an agent-delivered message in a computer-based learning environment was effective in promoting learner self-efficacy (e.g., Huang & Mayer, 2019). The duration of the message is about 52 seconds.

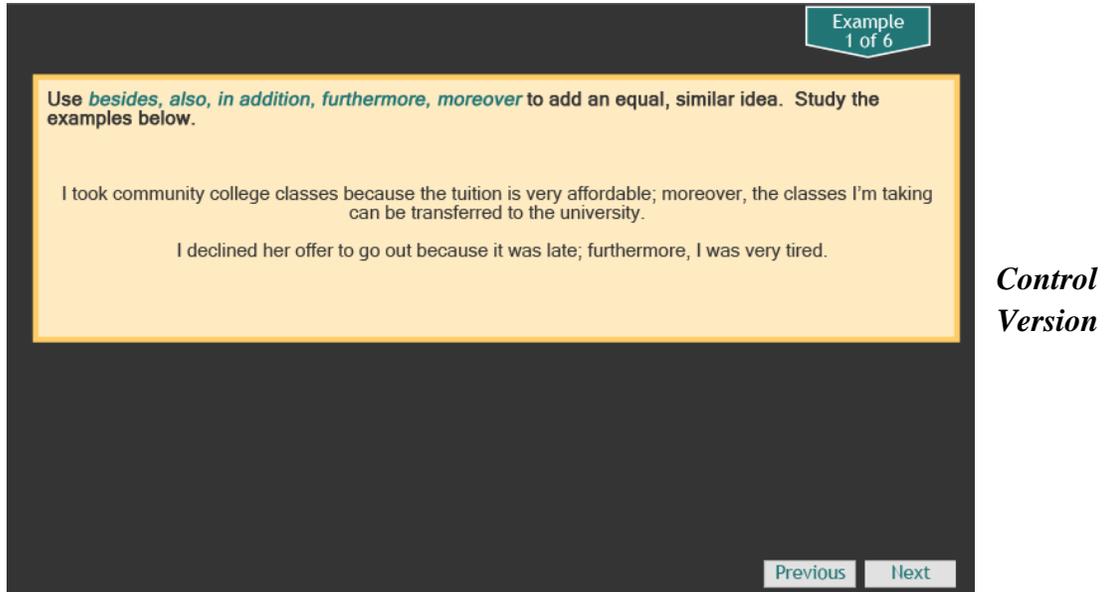
Hi, I'm Maddie. I volunteered to go through this module with you. I took this class last semester and was nervous because I didn't think my writing was very good, but I was surprised at how much better I got with some practice. There was an older student named Samantha who went through my modules with me and encouraged me a lot. Now that she's graduated, I asked the professor if I could come back and help encourage other people through their modules. I'm an accounting major, and English isn't my favorite subject, but I have learned to be a

better writer and make fewer mistakes when writing. With a little effort, I know you can improve your writing, too. The module you're about to do was the first one I did, and it wasn't as hard as I thought it would be. I'll pop in and check on your progress every now and then, but I know that you can do this! Let's get started, and we'll be done before you know it.

Parts two and three were meant to provide instruction in the subject. The module defined compound sentence and conjunctive adverb before showing participants examples of six ways in which conjunctive adverbs are used to express relationships between ideas presented in two independent clauses: those that contain similar or equal ideas (e.g., also, too, as well), that add an expected result (e.g., as a result, consequently, therefore), that add an unexpected or surprising continuation (e.g., nevertheless, however), that add a contrast (e.g., on the other hand), that give an alternative possibility (e.g., otherwise), or that provide an example (e.g., for instance). In addition, this section of the module provided students with a pattern for combining independent clauses with conjunctive adverbs. Figure 3.3 is a screenshot of one of the example slides for conjunctive adverbs. Again, the only difference between the slides in the control group and the Peer group was the inclusion of the pedagogical agent. In this case, the agent remained as a static image rather than as an animated agent while the participants went through the six example slides.

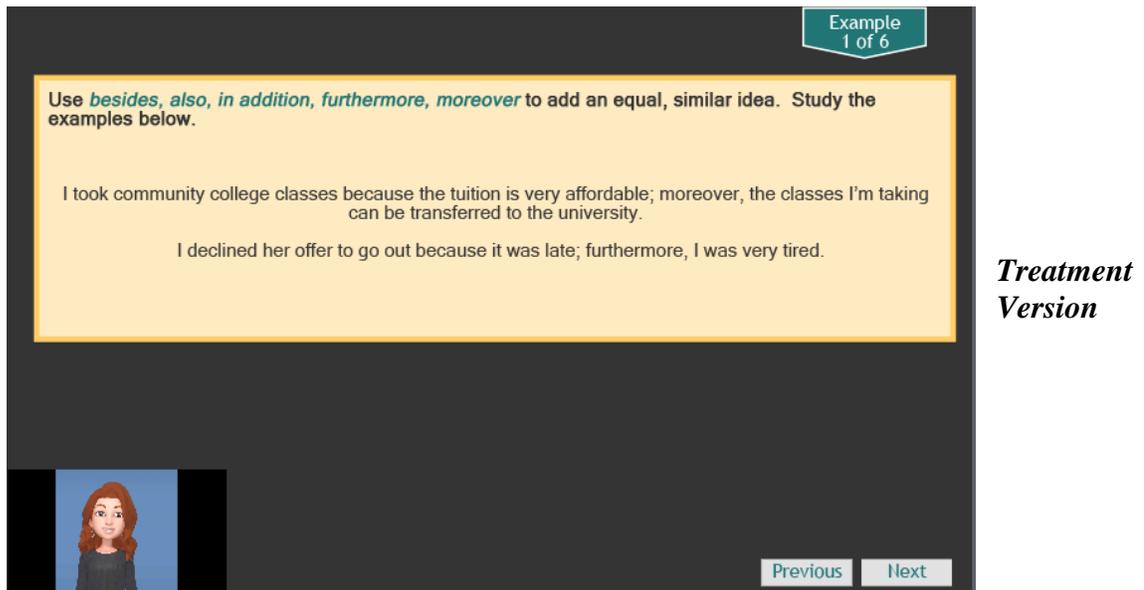
Figure 3.3

Screenshots of Conjunctive Adverb Slide from the Control Version (Top) and the Treatment Version (Bottom)



This screenshot shows a slide titled "Example 1 of 6" with a yellow background. The text on the slide reads: "Use *besides, also, in addition, furthermore, moreover* to add an equal, similar idea. Study the examples below." Below this, two example sentences are provided: "I took community college classes because the tuition is very affordable; moreover, the classes I'm taking can be transferred to the university." and "I declined her offer to go out because it was late; furthermore, I was very tired." At the bottom right, there are "Previous" and "Next" navigation buttons.

***Control
Version***



This screenshot shows a slide titled "Example 1 of 6" with a yellow background. The text on the slide is identical to the Control Version: "Use *besides, also, in addition, furthermore, moreover* to add an equal, similar idea. Study the examples below." followed by the same two example sentences. At the bottom left, there is a small video window showing a woman with red hair. At the bottom right, there are "Previous" and "Next" navigation buttons.

***Treatment
Version***

The module concluded with the fourth part, which was designed to allow students to practice the skills learned in parts two and three and to receive feedback on their practice. Three practice exercises asked participants to combine two independent clauses using a specified conjunctive adverb. The practice questions included feedback based on

the learner's response. Two sets of feedback messages were developed, one for the control version and the other for the treatment version of the module. Each set of feedback messages includes separate messages for the correct answer and incorrect answers for each practice item. For the treatment version, the feedback messages attempted to foster a growth mindset, emphasizing the importance of efforts in learning outcomes. For the control version, the feedback messages were general and had no reference to the importance of efforts. For example, when the learner successfully completed the practice question, successful answers in the control group were greeted with comments like "Correct! Great work!" or "Correct! Fantastic!" In the Peer group, the pedagogical agent was present on screen when textual feedback was given, which contained messages such like "You did wonderful job! You seem to be a hard worker!" When the learner incorrectly answered the practice question, they were given messages such as "Sorry, that's not quite right" (in the control group) and "That's not quite right. Don't worry, though; it's just the first practice question. You can do this!" (in the Peer group). Figure 3.4 and Figure 3.5 are screenshots of one of the practice questions with corresponding feedback to correct answer and incorrect answer, for the control group and the peer group, correspondingly.

Figure 3.4

Example of Feedback for Correct (Top) and Incorrect (Bottom) Answers in the Control Version

Read the simple sentences below and combine them into one compound sentence using "nevertheless."

I spent over a week working on my final paper. I did not finish it before the due date.

I spent over a week working on my final paper; nevertheless, I did not finish it before the due date.

Correct! Great work! - Click **Enter** again to continue.

Enter

***Feedback
for Correct
Answer***

Read the simple sentences below and combine them into one compound sentence using "nevertheless."

I spent over a week working on my final paper. I did not finish it before the due date.

I spent over a week working on my final paper, nevertheless I did not finish it before the due date

Sorry, that's not quite right. The correct answer is:
"I spent over a week working on my final paper; nevertheless, I did not finish it before the due date."
Click **Enter** again to continue.

Enter

***Feedback
for Incorrect
Answer***

Figure 3.5

Example of Feedback for Correct (Top) and Incorrect (Bottom) Answers in the Treatment Version

The figure consists of two vertically stacked screenshots of a learning interface. Both screenshots have a black background. At the top of each, white text reads: "Read the simple sentences below and combine them into one compound sentence using 'nevertheless.'" Below this is a light blue box containing the text: "I spent over a week working on my final paper. I did not finish it before the due date." Underneath the blue box is a white text input field. In the top screenshot, the input field contains the correct answer: "I spent over a week working on my final paper; nevertheless, I did not finish it before the due date." Below the input field is a yellow feedback box with the text: "Good job! Your efforts are really paying off. Keep it up! Click Enter again to continue." In the bottom screenshot, the input field contains an incorrect answer: "I spent over a week working on my final paper, nevertheless I did not finish it before the due date." Below the input field is a yellow feedback box with the text: "That's not quite right. Don't worry, though; it's just the first practice question. You can do this! The correct answer is: 'I spent over a week working on my final paper; nevertheless, I did not finish it before the due date.'" At the bottom of each screenshot is a small avatar of a woman with red hair and a teal "Enter" button.

*Feedback
for Correct
Answer*

*Feedback
for
Incorrect
Answer*

Except for the inclusion of the Peer Agent—with corresponding motivational and effort feedback messages—in the experimental group, the learning module was identical in both conditions. All of the slides which presented learning content contained the same text and page layout in both conditions. In the Peer group, the pedagogical agent was

animated to deliver a motivational message (in the format of a video) to the participants at the beginning of the module and appeared as a static image on slides which presented examples or feedback to the learners. All of the learning content was delivered via text on the slides themselves, as in the control version of the module.

Assessment Materials

The module also included several assessment materials designed to assess the four dependent variables under examination in this study: a pre-test and post-test, a student self-efficacy measure, a student attitude survey, and an agent persona scale. These measures are described in detail below.

Student Performance

Student performance was measured by the scores on the pre-test and post-test (see Appendix B). The items on the pre-test and post-test were identical, and they were adapted from items created by the author for use in his face-to-face English classes. Participants' knowledge of rules surrounding conjunctive adverbs and their proper usage was measured, which consisted of three parts: (a) a True/False section which asked students four questions about their prior knowledge of important grammar concepts related to forming compound sentences with conjunctive adverbs (e.g., if they could accurately differentiate between a dependent and an independent clause, which is a necessary prerequisite to create compound sentences), (b) a section which provided students with two simple sentences and asked them to correctly combine the two sentences using a conjunctive adverb (consisting of five questions), and (c) a section which asked students to produce their own compound sentences using a conjunctive adverb (consisting of three questions). A total of 12 test items were included, with the

maximum score of 34 points. True/False questions were worth one point each and were automatically scored in Blackboard. Questions in the second section and the third section were worth three points and five points each, respectively, and they were manually scored. Partial credit was given in the second and third sections if participants missed part of the question but got another part of the answer correct (e.g., correctly using the semicolon, correctly using a conjunctive adverb, etc). It should be noted that during the manual grading, the researcher was able to see whether the test belonged to a participant in the control group or treatment group; however, all questions were graded as objectively as possible based on the scoring criteria noted above. Cronbach's alpha (α) of the items was .84 and .71 for the pre-test and post-test, respectively. Cronbach's alpha assesses the internal consistency of a measure. There is some disagreement about what makes an acceptable α level, but a general rule is that an α of approximately .70 indicates acceptable scale reliability, with a score of .80 being much better and a score substantially below .70 being considered unacceptable (Field, 2015). This measure suggests that both assessments have an acceptable level of reliability.

Self-Efficacy

In addition to the pre-test, participants also completed a self-efficacy measure (see Appendix C) before proceeding to the learning module. This self-efficacy measure was adapted from Bandura (2006) and was designed on a 10-point Likert scale. The measure was task-specific, which consisted of ten skills related to the content that they would encounter in the learning module (e.g., *State the rules for using conjunctive adverbs in sentences when writing*). Participants were directed to rate how certain they were that they could effectively perform each of those skills on a scale ranging from 0 (cannot do at

all) to 10 (highly certain can do). The purpose of this pre-measure was to check the equivalence of the two groups on self-efficacy prior to the instruction. In order to evaluate any changes in self-efficacy beliefs as a result of the intervention, this measure was repeated at the conclusion of the learning module, and the results between the treatment group and the control group were compared to examine if the difference was significantly different. The items on the self-efficacy scale were identical in both situations. In addition, an attention-check item was included in the post-test self-efficacy survey to help ensure that learners were still paying attention to the specific questions at a high-level as they neared the end of the module. Cronbach's alpha (α) of the items was .94 and .96 for the pre-test self-efficacy measure and the post-test self-efficacy measure, respectively. These α levels suggest that both surveys exhibit a very high level of internal consistency.

Attitude

Upon completion of the post-test and the final self-efficacy measure, participants then completed an attitude survey. The instrument for measuring student attitudes towards the lesson was a 10-item survey using a 5-point Likert scale (5 = Strongly Agree; 1 = Strongly Disagree) that asked students to rate the extent to which they agreed or disagreed with the statement given. The survey (see Appendix D) was adapted from Olina et al. (2006). The Likert scale questions were divided into three categories, with four items testing Motivation (e.g., *I liked studying the grammar rules in this module*), three items testing Perceived Difficulty (e.g., *I had to work hard to learn the grammar rules presented in this module*), and three items testing Perceived Effort (e.g., *I did my best to learn the grammar rules presented in this module*). Two items in the Perceived

Difficulty category were reverse coded before the analysis of the data. Cronbach's alpha (α) of the items on the attitude scale was .84.

In addition to the quantitative measures, qualitative open-response questions were also added to both conditions as shown in Appendix D. Four questions were asked to those in the treatment condition, and three questions were asked in the control condition. For both conditions, the first two questions asked were identical: "What did you like best about the module? Please explain in a few sentences," and "What did you like least about the module? Please explain in a few sentences." The last question asked was very similar for both conditions, for both asked about how helpful it was to work in this particular module compared to working with a human instructor. For the control group, the question asked about a "self-paced, computer-based module," and for the treatment group, the question asked about working with a "virtual instructor." Learners in the treatment group also had a question that did not appear in the control group that asked about the effect of working with a virtual agent and how that influenced their perception of the module. The purpose of these open-ended questions was to better understand learners' experience and perceptions in their learning process, including what they liked and disliked about the module as well as their perceived effect of the module in general and the peer agent specifically (for the peer-agent group).

Learners' Agent Perception

Learner perception of agent persona was assessed via an instrument developed by Ryu and Baylor (2005). The instrument was a 25-item survey which asked students to indicate, using a 5-point Likert scale (5 = Strongly Agree; 1 = Strongly Disagree), the extent to which they agreed or disagreed with statements about how they perceived the

agent's persona (see Appendix E). The items examined whether or not students perceived the agent to Facilitate Learning (e.g., *The agent kept my attention*), to be Credible (e.g., *The agent was knowledgeable*), to be Human-Like (e.g., *The agent has a personality*), and to be Engaging (e.g., *The agent was motivating*). Cronbach's alpha (α) of the items on the agent persona scale was .95.

Research Design

An experimental, quantitative research design with two randomly selected groups featuring a pre-test and post-test was used for this study to examine the effectiveness of including a peer-like, animated pedagogical agent into an online English composition module on student performance, attitude, and self-efficacy. Quantitative results were collected for the pre-test and post-test, the self-efficacy surveys, the attitude survey, and the peer persona scale. In addition to the quantitative data, a few open-ended qualitative questions were asked in the attitude survey to allow the researcher to see how participants reacted to their experiences in the module and to allow for a more detailed discussion of the quantitative results.

Independent Variable

In this study, one independent variable was present: pedagogical agent presence (inclusion of the agent vs. absence of the agent). The effects of pedagogical agents on student performance, self-efficacy, and attitude were examined in two conditions: computer-based English grammar instruction with a Peer agent (treatment condition) and with no agent (control condition). In the Peer agent condition, the agent introduced herself as Maddie, a college student and Accounting major who had taken this English module previously and wanted to come back in order to help other students taking the module for the first time.

Maddie was conceptualized according to visual appearance, an enthusiastic tone of voice, and personal, colloquial dialogue. Maddie appeared at the beginning of the module to give a brief introductory speech, and after that, she appeared on the slides featuring examples and feedback to the learners. For the control group in the study, written texts and completed examples were displayed on screen, and the examples in the control group were the same as the examples used in the experimental group. Specific details about the instruction for the treatment group (inclusion of the agent) and the control group (absence of the agent) is discussed in the "Instructional Module" section above.

Dependent Variables

There were four dependent variables under examination in this study: performance, self-efficacy, attitude, and student perception of agent persona. Details about how each of these variables was measured were mentioned in the Assessment Materials section above.

Student performance refers to the extent to which participants' test scores improved from the pre-test to the post-test after the completion of the module.

Student self-efficacy refers to the extent to which the participants believed they were capable of learning the various grammatical rules and concepts necessary to successfully complete the tasks given.

Student attitude refers to how learners felt about learning grammatical concepts in the module. Attitude was determined by their self-reported motivation, their perceived ease of learning, and their perceived difficulty of learning the module.

Student perception of the agent refers to how the participants viewed the peer-like, animated pedagogical agent on four criteria: facilitating learning, being credible, being human-like, and being engaging.

Ethical Considerations

Because the current study required the collection of data from human subjects, including gathering of demographic information, an approval form for the inclusion of human subjects was filed with the Institutional Review Board at the institution from which participants were recruited (Appendix F). All procedures were completed in accordance with the guidelines laid out in the IRB approval form, and all students were informed of the implied consent document issued by the Institutional Review Board (Appendix G). Student confidentiality was maintained throughout the study.

Procedure

After developing the instructional module and creating or editing the tests and survey instruments, the researcher requested the creation of an organizational shell in Blackboard at the study institution where all materials could be stored and where participants would complete the module. Upon approval from the Institutional Review Board, a request for volunteers was sent out via e-mail to all currently enrolled undergraduate students at the university. Three reminder emails were sent out after the original email invitation within a month. Students who responded to the volunteer request were then enrolled in the study's organization site on Blackboard and were asked to confirm a day and time to complete the module. Each participant received a \$12 Amazon gift card for their participation in the study.

The study was conducted during the Spring 2021 semester, and because of concerns over the coronavirus pandemic, responses were collected in an online format

only. For the online data collection, survey respondents participated in an online data collection meeting using the cloud-based conferencing software Zoom. Most sessions averaged between 3-5 students, though some sessions were smaller or larger depending on when participants were available. An electronic consent form (See Appendix G) was built into the module and displayed to the participants prior to the study. At the beginning of the instruction, the author instructed the participants on the contents of the consent form, which advised them of their rights in regards to the project, detailed the parameters of the study, and assured them that their confidentiality and anonymity would be maintained. The form also indicated their continued participation with the research would imply their consent. After the reading of the consent form, the author made the module visible to the participants and instructed them to complete each item in the order in which it was presented, at which point the participants worked independently at their own pace to complete the module. Even though the participants were working on their own, the author remained with the participants in order to observe the process and to be available in case learners had questions or encountered technical difficulties.

Participants were randomly assigned to one of two conditions: a treatment group with a Peer agent or a control group with no agent. Before the self-paced multimedia lesson began, participants completed a pre-test survey which included demographic information and a self-efficacy assessment, after which they completed a pre-test to determine their content knowledge before the intervention began. After the pre-test was completed, participants completed an online grammar module in one of the two versions (treatment or control) designed in Adobe Captivate.

Upon completion of the multimedia lesson, participants completed the post-test assessment, as well as the attitude and self-efficacy surveys. Those in the treatment condition also completed the agent persona instrument.

Data Analysis

To test the hypotheses presented in Chapter I, both quantitative and qualitative data were collected during the pre-test and post-test phases of the experiment.

First, an independent samples *t*-test was conducted to check the equivalence of the peer-agent group and the control group on the pre-measures of the study, including the pre-test scores and the pre-self-efficacy measure prior to the instruction. This test was selected because it is used to examine differences between groups (Field, p. 366), and it was necessary to see that there was no statistically significant difference between the two conditions before the module began. This test is a parametric test and assumes that there are no significant outliers in either group, that each participant only belongs to one group, that the data for each group is normally distributed, and that there is homogeneity of variances. Results were said to be statistically significant at a *p*-value equal to or less than .05.

The first research question examined whether a peer-like, animated pedagogical agent would impact student performance in an online English composition module. It was hypothesized that a peer-like, animated agent would significantly improve student performance in the treatment group when compared to the control group. It was further hypothesized that the treatment group would see a significant improvement in performance between the pre-test and the post-test and that the control group would not see a similar significant improvement. This hypothesis was further tested with an independent samples *t*-test. Also, a paired-samples *t*-test was conducted on both the

treatment group and the control group to examine changes in their scores from the pre-test to the post-test. This test was selected because it is used to examine the means of measurements taken from the same sample. It is also a parametric test, and it assumes there are no significant outliers and that there is normality in the way in which the difference between scores is distributed (Field, p. 371). Statistical significance was set at a p -value of .05 or lower. Descriptive statistics on the means and standard deviation for the pre-test score and the post-test score were also reported.

The second research question sought to determine whether a peer-like, animated pedagogical agent could improve student self-efficacy in an online English module. It was hypothesized that the peer-like, animated pedagogical agent would significantly improve student self-efficacy beliefs about learning grammar for the treatment group when compared to the control group. It was also believed that the treatment group would see a statistically significant improvement in their self-efficacy scores from the pre-measure to the post-measure, while the control group would not see a similar increase in self-efficacy. An independent samples t -test was performed on the post-self-efficacy survey to examine differences between the treatment and control groups. A paired-samples t -test was performed for both the treatment and the control groups to examine changes in self-efficacy from the pre-measure to the post-measure. Results were said to be statistically significant at a p -value equal to or less than .05. Descriptive statistics were also reported for the mean and standard deviation of the pre-self-efficacy and post-self-efficacy measures.

The third research question investigated how a peer-like, animated pedagogical agent affected student attitudes towards grammar instruction in an online English

composition module. It was hypothesized that the treatment group would see a significant improvement in attitude when compared to the control group. An independent samples *t*-test was performed on the attitude survey to examine differences between the treatment and control groups. Statistical significance was set at a *p*-value of .05 or lower. Descriptive statistics on the means and standard deviation for each of the ten items on the attitude scale were also reported.

Open-ended questions were included on the attitude survey to allow for some qualitative analysis to better understand participants' perceptions of and experiences with the computer-based module. Participant responses were analyzed and coded following a thematic analysis approach to identify, analyze, and report themes that emerged from these responses (Nowell et al., 2017). At the end of the data collection period, participant comments were placed in an Excel spreadsheet, and the researcher read through all of the responses left by the participants twice to get a sense of what general patterns seemed to be emerging from the data. Data from the treatment group and the control group were read and analyzed independently. While reviewing the data, initial codes were generated for each question. Initial codes were broad at first but were then narrowed into more specific categories. Data from both groups were then put together and examined to see what common themes emerged. The researcher looked to see that items occurred repeatedly throughout the responses before considering them as "themes" in the responses, and these themes were generated inductively based on participant comments. Analysis of the data continued until no additional themes were identified. The responses from the treatment group were compared to the responses from the control group to see how each group experienced the module and to look for differences in their experiences.

The analysis of the open-ended questions also revealed similarities between their experiences in the online module. This data was used to enrich the quantitative data providing possible explanations for why the quantitative research hypotheses were met or rejected. The final research question examined how participants in the treatment group viewed the peer-like, animated pedagogical agent. Descriptive statistics on the means and standard deviation of each item on the persona scale were reported.

Summary

This chapter outlined the quantitative and qualitative measures that were used in the creation of this study. The chapter laid out participant demographic information, the procedures for conducting the study, the structure of the instructional modules and measures and surveys implemented, and the data analysis used to examine the dependent variables in question. The next chapter will describe the results of the study in detail.

CHAPTER IV: RESULTS

As discussed in Chapter one, the primary purpose of this study was to examine the effects of pedagogical agent on student performance, self-efficacy, and attitude among adult learners in an online English learning environment. Students' perceptions of agent persona were also investigated. This chapter contains the results from the quantitative instruments and the qualitative survey data collected in the course of this project. Quantitative data include participant performance scores (collected through a pre-test and a post-test), as well as their self-reported ratings on perceived task self-efficacy, attitude towards the learning module, and agent persona (collected through survey rating scales). Qualitative data include participant responses to open-ended attitudinal questions concerning their perceptions of and experiences with the online module they have studied. The dependent variables examined in this study included performance scores, task self-efficacy, attitude, and agent persona.

Research Questions

As noted in previous chapters, the general research questions which this study examined were:

RQ1: Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module impact student performance?

H_{1A}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student performance compared to the control condition.

H_{1B}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student performance between the pre-test and post-test for the treatment group. The control group without a peer-like, animated

pedagogical agent in an online English composition module will not significantly improve student performance.

RQ2: Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module influence student self-efficacy?

H_{2A}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student self-efficacy compared to the control condition.

H_{2B}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student self-efficacy comparing the pre-measure and post-measure for the treatment group. The control group without a peer-like, animated pedagogical agent in an online English composition module will not significantly improve student self-efficacy.

RQ3: Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module affect student attitudes towards grammar instruction?

H₃: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student attitudes compared to the control condition.

RQ4: How do learners perceive the peer-like pedagogical agent persona in an online English composition module?

The results of the study are presented below, with each result being organized according to the dependent variables. Group equivalence prior to the intervention was established before the main analyses for the research questions were conducted.

Group Equivalence Prior to the Intervention

To determine the group equivalence prior to the intervention, an independent-samples *t*-tests was conducted on the pre-test and pre-self-efficacy, respectively, to compare the treatment group and the control group on these two measures. The test indicated there was no statistically significant difference in the pre-test scores between the treatment group ($M = 10.76, SD = 8.40$) and the control group ($M = 8.90, SD = 8.64$); $t(40) = .706, p = .484, d = .218$. Similarly, there was no statistically significant difference on the mean rating of students' pre-self-efficacy between the treatment group ($M = 6.73, SD = 1.98$) and the control group ($M = 6.02, SD = 2.58$), $t(40) = 1.004, p = .322, d = .310$. The findings did not indicate a statistically significant difference in terms of the prior knowledge and perceived task self-efficacy of the two groups before they started the online module.

Findings for Research Question 1

RQ1: Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module impact student performance?

H_{1A}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student performance compared to the control condition.

H_{1B}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student performance between the pre-test and post-test for the treatment group. The control group without a peer-like, animated pedagogical agent in an online English composition module will not significantly improve student performance.

The first research question under investigation in this study sought to determine the extent to which the inclusion of a peer-like pedagogical agent in an online English composition module might positively influence student performance. This was measured by (1) comparing the mean score on a post-intervention test between the treatment group and the control group, (2) comparing the learning gain for both groups from the pre-test to the post-test, and (3) comparing the mean score of the pre-intervention test and the post-intervention test for the treatment group and the control group, respectively. It was hypothesized that the inclusion of a peer-like, animated pedagogical agent would significantly improve student performance in the treatment group compared to the control group. It was also hypothesized that the inclusion of a peer-like, animated pedagogical agent would significantly improve student performance between the pre-test and post-test for the treatment group but that the control group, without a peer-like, animated pedagogical agent, would not see a significant improvement in their performance.

Descriptive Statistics

Table 2 summarizes the descriptive statistics for student performance on the pre-test and the post-test per condition. In both conditions, the mean learner score on the pre-test was quite low, indicating low-levels of prior knowledge on the subject. On the post-test scores, both groups saw substantial improvements from their pre-test scores, with both groups improving by approximately twenty points (on a 34-point scoring scale) on average.

Table 2*Means and Standard Deviations on Student Performance Scores*

Condition	Pre-test		Post-test	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Control	8.90	8.64	30.33	3.76
Treatment	10.76	8.40	29.24	6.65

Note. Maximum score = 34**Difference of Students' Post-Test Performance between Groups**

In order to see the effect that the agent may have had on student performance as compared to the control group, an independent samples *t*-test was conducted to determine if there was a statistically significant difference between the treatment group and the control group on the mean score of the post-test. The *t*-test found that the average post-test score of the students in the treatment condition ($M = 29.24$, $SD = 6.65$) was not significantly different from the average post-test scores of the students in the control group ($M = 30.33$, $SD = 3.76$), $t(40) = -.657$, $p = .515$, $d = -.203$. These results suggest that the inclusion of the peer agent did not have a significant influence on student performance in the online English composition module as compared to the control condition, and Hypothesis 1A was rejected.

In addition, an independent samples *t*-test was used to conduct a gain score analysis to compare the improvement in test scores for both groups between the pre-test and the post-test to determine whether the rate of improvement was different for both groups. The results indicated that the average gain from the pre-test to the post-test for the treatment group ($M = 19.48$, $SD = 9.96$) was not statistically different from the

average gain of the control group ($M = 21.43$, $SD = 8.85$), $t(40) = -.1015$, $p = .316$, $d = -.313$.

Change of Student Performance from Pre-test to Post-test

A paired-samples t -test was conducted to investigate if there was a significant increase between student performance on the pre-test and student performance in the post-test in the treatment group and the control group, respectively. Results indicated there was a statistically significant difference in the scores for the pre-test ($M = 10.76$, $SD = 8.64$) and for the post-test ($M = 29.24$, $SD = 6.65$) of the treatment group; $t(20) = -8.49$, $p < .001$, $d = -1.854$. Similarly, there was a statistically significant difference in the scores for the pre-test ($M = 8.90$, $SD = 8.40$) and for the post-test ($M = 30.33$, $SD = 3.76$) of the control group; $t(20) = -11.100$, $p < .001$, $d = -2.422$. Results indicated that Hypothesis 1B was partially met because there was a significant improvement in the scores of the treatment group. The control group also saw a significant improvement from the pre-test to the post-test, which was not hypothesized.

Findings for Research Question 2

RQ2: Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module influence student self-efficacy?

H_{2A}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student self-efficacy compared to the control condition.

H_{2B}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student self-efficacy comparing the pre-measure and post-measure for the treatment group. The control group without a

peer-like, animated pedagogical agent in an online English composition module will not significantly improve student self-efficacy.

In order to examine the second research question, a self-efficacy survey was administered before the module and after the module to see if the participants' beliefs in their ability to learn specific grammar concepts related to forming compound sentences with conjunctive adverbs (e.g., *combine simple sentences into a compound sentence using an appropriate conjunctive adverb*) had increased. This was measured by (1) comparing the mean score on the post-self-efficacy survey between the treatment group and the control group, (2) comparing the self-efficacy gain for both groups from the pre-self-efficacy survey to the post-self-efficacy survey, and (3) comparing the mean score of the pre-self-efficacy survey and the post-self-efficacy survey for the treatment group and the control group, respectively. It was expected that the treatment group would show more improvement in this measure when compared with the control group, and it was hypothesized that the treatment group would see a significant increase in self-efficacy while the control group would not see significant improvement in their self-efficacy scores.

Descriptive Statistics

Table 3 summarizes the descriptive statistics for student perceived self-efficacy before and after studying the online module per condition.

Table 3*Means and Standard Deviations on Student Self-Efficacy*

Condition	Pre-Self-Efficacy		Post-Self-Efficacy	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Control	6.02	2.58	8.49	2.09
Treatment	6.73	1.98	8.80	1.28

Note. Maximum score = 10

Difference of Students' Post-Self-Efficacy between Groups

An independent samples *t*-test was conducted on the post-self-efficacy survey to determine if there was a difference in self-efficacy means between the treatment and control groups. The test found there was no statistically significant difference on the post-self-efficacy measure between the treatment group ($M = 8.80$, $SD = 1.28$) and the control group ($M = 8.49$, $SD = 2.58$), $t(40) = -.568$, $p = .573$, $d = .175$. These results would indicate that including the peer agent did not have a significant impact on learner self-efficacy beliefs in the online English composition module when compared with learners in the control condition, and Hypothesis 2A was rejected.

In addition, an independent samples *t*-test was used to conduct a gain score analysis to compare the improvement in self-efficacy for both the treatment and the control group between the pre-self-efficacy and the post-self-efficacy survey to determine whether the rate of improvement was different for both groups. The results indicated that the average gain for the treatment group ($M = 2.07$, $SD = 1.44$) was not statistically different from the average gain of the control group ($M = 2.48$, $SD = 1.85$), $t(40) = -.797$, $p = .43$, $d = -.246$.

Change of Student Self-Efficacy from Pre-measure to Post-measure

A paired samples *t*-test was conducted for both the control group and the treatment group to determine how each group's self-efficacy beliefs were impacted as a result of studying their version of the online English composition module. The test found there was a statistically significant difference in the treatment group between the pre-measure self-efficacy score ($M = 6.73, SD = 1.98$) and the post-measure self-efficacy score ($M = 8.80, SD = 1.28$), $t(20) = -6.57, p < .001, d = -1.43$. In addition, the test found a statistically significant difference in self-efficacy for the control group from the pre-measure self-efficacy score ($M = 6.02, SD = 2.58$) and the post-measure self-efficacy score ($M = 8.49, SD = 2.09$), $t(20) = -6.123, p < .001, d = -1.34$. These results show that both groups experienced a statistically significant increase in self-efficacy as a result of the module, and it does not indicate that the agent alone would be responsible for improvements on this measure. Hypothesis 2B was only partially supported. As expected, the treatment group experienced a significant increase in self-efficacy. The control group also experienced a significant increase in self-efficacy, which was not expected.

Findings for Research Question 3

RQ3: Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module affect student attitudes towards grammar instruction?

H₃: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student attitudes compared to the control condition.

The third research question in the study sought to determine if including a peer-like pedagogical agent in an online English composition module would have a more

positive effect on student attitude than if the students had no agent present. It was believed that the treatment group would see statistically significant improvement in their attitude towards the grammar instruction when compared to the control group. Findings on this question include analyses of both quantitative data (survey ratings) and qualitative data (open-ended survey questions) in the attitude survey (Appendix D). This survey was given upon completion of the grammar module.

Descriptive Statistics

Table 4 below summarizes the mean scores and standard deviations on student attitudes per condition. Overall, both the control group ($M = 4.18, SD = 0.58$) and the treatment group ($M = 4.16, SD = 0.61$) positively rated their attitudes towards the version of online English composition module that they received.

Table 4

Means and Standard Deviations on Student Attitudes

	<i>M</i> (<i>SD</i>) - Control	<i>M</i> (<i>SD</i>) – Treatment
Motivation		
1. I liked studying the grammar rules in this module	4.00 (0.71)	3.95 (1.07)
2. Studying the grammar rules in this program was more interesting than studying them in a typical English course.	3.57 (1.29)	3.71 (1.10)
3. Learning proper grammar rules for conjunctive adverbs is valuable for making me a better academic writer.	4.76 (0.54)	4.71 (0.56)
4. Incorporating correct grammar rules into my writing will make my writing more interesting.	4.62 (0.59)	4.48 (0.81)
<i>Motivation Mean</i>	4.24 (0.62)	4.21 (0.67)
Perceived Ease of Learning		
5. It was easy to learn from this program.	4.48 (0.81)	4.33 (0.80)

6. I had a hard time understanding how to apply the grammar rules learned in this module. (<i>reverse coded</i>)	4.10 (1.04)	4.38 (0.74)
7. I had to work hard to learn the grammar rules presented in this module. (<i>reverse coded</i>)	3.95 (1.07)	4.29 (0.72)
<i>Perceived Ease of Learning Mean</i>	4.02 (0.82)	4.21 (0.54)
Perceived Effort		
8. I did my best to learn the grammar rules presented in this module.	4.67 (0.48)	4.33 (0.80)
9. I carefully studied the explanations and examples.	3.95 (0.97)	3.76 (1.26)
10. I was able to remain completely focused on the material during the entire module.	3.67 (1.20)	3.62 (1.32)
<i>Perceived Effort Mean</i>	4.10 (0.75)	3.90 (1.01)
Overall Mean	4.18 (0.58)	4.16 (0.61)

Note. Maximum score = 5

Difference of Students' Attitudes between Groups

An independent samples *t*-test was conducted on the overall mean score of student attitudes between the control group and the treatment group. The test found that the overall results of the attitude scale were nearly identical between the treatment group and the control, and there was no statistically significant difference evident, $t(40) = -.103$, $p = .92$, $d = -.032$. As a result, Hypothesis 3 was rejected.

Themes Emerged from Responses to Open-Ended Questions

As part of the student attitude survey, participants in both conditions were asked to provide qualitative feedback on their experience in the online English composition module (Appendix D). The open-ended questions were included in the experiment to help provide context and to help explain participant responses in the quantitative data. Both conditions were asked what they liked best and what they liked least about the modules. Each condition was also asked about how working in this environment (i.e.,

with an agent for the treatment group and working in a self-paced computer module for the control group) compared with being able to work with a human instructor. The treatment group had one additional question which asked about how the virtual agent impacted their perception of the module. Overall, participants in both the control group and the treatment group were generally positive towards their experiences during the module, though learners did also report some difficulties and made comments which suggested possible areas of improvement.

On Question 1 in the treatment group, participants described what they liked best about completing the online learning module. Seven participants specifically mentioned that working with the pedagogical agent, Maddie, was what they most liked about the program. Others described how they liked the interactivity of the module and how they were able to practice with examples and get instant feedback on the lesson. Two participants said that they enjoyed that the module was self-paced.

For the control group, there were some similarities in responses with the treatment group. For example, learners in the control condition also mentioned the inclusion of interactive examples and feedback and the pacing of the course. Others described that they liked that the module was very direct and to the point.

On Question 2 in the treatment group, several learners indicated that Maddie was not helpful to them. Three learners said that Maddie was "annoying," and two learners felt that including the agent slowed them down in the module, which may have negated some of the positive aspects of having a self-paced module. Five respondents said that they wished that the module had provided an audio voice-over on the text so that they

would not have had to read so much material on the screen. Some respondents said that there was nothing they didn't like about the module.

When asked what they did not like about the module, the dominant theme in the control group was that there was a lot of reading involved in the module; a total of six respondents noted this in their comments. Two others mentioned that the auto-grading function for practice problems would count a practice question wrong if there was a typo, misspelling, or extra spacing in the submission. Eight respondents said that they enjoyed the module or did not have anything they disliked about it.

When asked how working with the virtual agent compared to working with a human instructor, treatment group respondents had a mix of positive and negative feedback. Some respondents felt that Maddie was too distracting to be beneficial. Others said that she was encouraging and a fun part of the experience. Two participants indicated that she did not have much of an effect.

Similarly, participants in the control group were also asked about how working in their module compared with working with a human instructor. Eleven participants mentioned that they preferred the self-paced nature of the online learning module as opposed to learning in class with an instructor. At the same time, other learners mentioned that they generally preferred learning with a human or that it would have been helpful to have a human instructor working in tandem with the virtual peer. Two respondents mentioned being more engaged with a human instructor.

Finally, participants in the treatment group were asked about how the inclusion of the pedagogical agent influenced their perceptions of the learning module. For some learners, having Maddie present was not helpful. Some specifically mentioned that it

would have been helpful to have an instructor or agent present who could answer questions and not just provide motivational messaging. At the same time, several participants found her to be encouraging and thought that having her there was preferable to learning alone.

Table 5 provides a summary of the qualitative themes that emerged from the comments left in the open-ended questions by the treatment group. Table 6 provides a summary of the themes which appeared in the responses left by the control group.

Table 5

Summary of Qualitative Themes in the Treatment Group

Questions	Themes	Examples
What did you like best about the module?	Working with the pedagogical agent	"I enjoyed the virtual teacher. She was easy to follow along with."
		"I really liked that there was a person explaining everything to me because it's easier to learn for me if I have someone guiding me."
	Interactive and immediate practice and feedback	"The interactive parts of the module. I am more of a hands on and visual learner, so having ways to continually be engaged helps me retain the content."
		"I thought the practice questions were very useful for practicing what we just learned."
Self-paced		"I liked the use of detail and EXAMPLE SENTENCES."
		"I liked that it was self-paced. It gave me the freedom to skip over redundant information while picking up the information that I wanted to have."
What did you like least about the module?	Maddie	"I did not like the talking bitmoji. She was sort of annoying and creepy."
		"I did not like the animated person

		because it was a little weird."
		"I did not like the talking person for a while in the middle. I already kinda knew the topic, so I didn't need her to take more time explaining it."
	Lack of audio / voice-over	"Too much plain writing without voice-overs."
		"I honestly prefer being read the material when working online, similar to lecture seminar approaches. Even having that option would help me focus better."
Compared to working with a human instructor, how helpful was working with your virtual instructor?	Negatives	"It was bit distracting."
		"I think I could have learned the same material more quickly without her."
	Mixed	"The virtual instructor was kind of helpful but also took longer. My perception was that it made it seem more friendly."
		"She was positive, which I liked. She did not make comments that made me feel bad about getting the question wrong. Again, the teeth being visible while she was talking was a little off-putting."
	Positives	"It was enjoyable and fun!"
		"A virtual instructor was great. It helped me stay focused and finish strong."
		"The virtual instructor's presence was definitely helpful and felt like I was in a face-to-face course."
What effect did working with a virtual instructor have on your perception of this module?	Not helpful	"She did not offer a lot of insight on the actual grammar; she was more like a distracting coach while I complete the module."
	Mixed	"It was encouraging and motivating, but not having the option to do cooperative learning wasn't helpful."

	"The virtual peer was nice for encouragement, while I would have liked a human instructor to ask more targeted questions."
	"She made the module feel more interactive but did not provide additional academic support."
Positive	"Definitely better than nothing. I hate not having an instructor for online classes, so I see it as a good alternative. Especially if professors aren't willing to record lectures." "Even though the peer is like a cartoon character, it still provides more connection than having to view the slides alone and practice on my own." "I would say that having a person face-to-face would be more helpful. However, the online instructor is better than having to do the work completely on your own."

Table 6

Summary of Qualitative Themes in the Control Group

Questions	Themes	Examples
What did you like best about the module?	Interactive and immediate practice and feedback	"I liked that it was interactive with examples on how to apply the rules I was taught." "I liked the presentation of the examples that were followed by basically "do it yourself" problems. This made it very smooth and simple to apply what I learned in the module."
	Direct	"How easy and straightforward the learning module was; I feel like teachers tend to assign long-winded homework that is boring and does not make me want to learn. This was fun and interactive!"

	Self-paced	"I liked that I could work at my own pace, and I could move on when I was ready. I liked that there was a section to practice some on my own."
What did you like least about the module?	Amount of reading	"I did not like that I had to read to myself." "It was very boring. It was equivalent to reading off a PowerPoint."
	Marking of errors in practice questions	"I accidentally put a space between the word and semicolon on one of my sentences, and it counted it wrong. Which, it is wrong, but maybe have a way that shows the answer isn't completely wrong?"
Compared to working with a human instructor, how helpful was working with a self-paced, computer-based module?	Enjoy self-paced instruction	"This module was very helpful, and I loved that it was self-paced so I didn't feel like I needed to rush and get done the quickest. I took my time to read the examples and complete the module." "It was very helpful because I enjoy going at my own pace. It was helpful to be able to go quicker through things I already had a grasp on and go over the things I wasn't sure about slower and backtrack if I thought I missed something."
	Human instruction	"I prefer human instruction in my learning, so I would have preferred learning this in person. However, the content was relatively simple....so the online module was perfect of this content." "I enjoy self-paced computer modules if an instructor is available to answer questions...but I sometimes struggle If I complete a module without getting my questions answered by a professor."

Findings for Research Question 4

RQ4: How do learners perceive the peer-like pedagogical **agent persona** in an online English composition module?

The final research question in the study examined how learners perceived the pedagogical agent as she went through the module with them. Participants in the treatment group were given a persona scale (Appendix E) which measured their perceptions of the agent's facilitation of learning, credibility, human-like qualities, and engagement. Mean scores and standard deviations are provided in Table 7.

Table 7

Means and Standard Deviations on Agent Persona

	Mean	SD
Facilitating Learning		
The agent led me to think more deeply about the presentation.	3.10	1.22
The agent made the instruction interesting.	3.67	1.16
The agent encouraged me to reflect what I was learning.	3.90	1.00
The agent kept my attention.	3.81	0.81
The agent presented the material effectively.	3.52	1.29
The agent helped me concentrate on the presentation.	3.19	1.40
The agent focused me on the relevant information.	3.67	1.32
The agent improved my knowledge of the content.	3.29	1.31
The agent was interesting.	3.95	0.74
The agent was enjoyable.	3.71	1.06
<i>Facilitating Learning Mean</i>	3.58	0.89
Credible		
The agent was knowledgeable.	3.62	0.97
The agent was intelligent.	3.52	0.93
The agent was useful.	3.57	1.25
The agent was helpful.	3.81	1.03
The agent was peer-like.	3.90	1.18
<i>Credible Mean</i>	3.69	0.85
Human-like		
The agent has a personality.	4.14	0.85
The agent's emotion was natural.	3.71	1.06
The agent was human-like.	3.67	1.07

The agent's movement was natural.	3.05	1.12
The agent showed emotion.	4.00	0.63
<i>Human-like Mean</i>	3.71	0.69
Engaging		
The agent was expressive.	4.10	0.94
The agent was enthusiastic.	4.62	0.50
The agent was entertaining.	4.00	0.89
The agent was motivating.	3.71	1.19
The agent was friendly.	4.62	0.59
<i>Engaging Mean</i>	4.21	0.60
Overall Mean	3.75	0.72

Note. Maximum score = 5

Results indicated that the agent was perceived most favorably in terms of being engaging ($M = 4.21$; $SD = 0.60$) and was perceived least favorably in terms of facilitating learning ($M = 3.58$; $SD = 0.89$). The agent's highest ratings were on items asking about her being perceived as friendly ($M = 4.62$; $SD = 0.59$) and enthusiastic ($M = 4.62$; $SD = 0.50$). The agent was largely perceived as human-like, but learners did not always perceive her movements as natural ($M = 3.05$; $SD = 1.12$).

Summary

This chapter provided detailed information on the analysis of the data collected during the research study. Quantitative results were given for each of the four variables in question—student performance, student self-efficacy, student attitude, and student perception of the pedagogical agent. Qualitative results were reported for the open-ended questions given at the end of the attitude scale. The quantitative results were analyzed using IBM's SPSS software. The qualitative results helped provided more information on possible effects on student self-efficacy, student attitude, and student perception of the pedagogical agent.

The results of the study did not indicate a statistically significant difference between the treatment group and the control group on any of the dependent variables

under study: student performance, student self-efficacy, or student attitude. Results on the peer persona scale indicated that participants did detect the agent as having a distinct persona. The study did show that both groups experienced an improvement in performance and self-efficacy as a result of completing the online module. The next chapter will discuss each of these results in more detail.

CHAPTER V: DISCUSSION

This section discusses the findings from the analyses conducted to test the hypotheses made on the key research questions under investigation. The research questions examined in this study were:

- 1) Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module impact student performance?

H_{1A}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student performance compared to the control condition.

H_{1B}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student performance between the pre-test and post-test for the treatment group. The control group without a peer-like, animated pedagogical agent in an online English composition module will not significantly improve student performance.

- 2) Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module improve student self-efficacy?

H_{2A}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student self-efficacy compared to the control condition.

H_{2B}: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student self-efficacy comparing the pre-measure and post-measure for the treatment group. The control group without a peer-like, animated pedagogical agent in an online English composition module will not significantly improve student self-efficacy.

3) Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module affect student attitudes towards grammar instruction?

H₃: A peer-like, animated pedagogical agent in an online English composition module will significantly improve student attitudes compared to the control condition.

4) How do learners perceive the peer-like pedagogical agent persona in an online English composition course?

This section also discusses the implications and limitations of the study and makes suggestions for future areas of research.

Analysis of the data found there were no statistically significant results between the treatment group and the control group on student performance, student self-efficacy, and student attitudes. However, a comparison of the pre-test and post-test within each group indicated there were significant improvements in student performance, with both the treatment group and the control group seeing an increase of approximately 20 points in the average score at the end of the study. The same pattern was detected for a comparison of the pre-self-efficacy and post-self-efficacy. Both the treatment group and the control group saw a noticeable improvement in self-efficacy as a result of studying the online English composition module. Results of the peer persona scale showed that, overall, the agent was perceived as being able to facilitate learning, being credible, being human-like, and being engaging. Qualitative data collected alongside the quantitative data provided a clearer picture of where potential shortcomings in the design of the module may be found and improved in future research.

A discussion of these results is included in the following sections. When appropriate, results found in the qualitative portion of the study will be used to provide

further explanations and support for the information found in the quantitative section of the study.

Discussion of Findings

Research Question 1: Effect on Student Performance

RQ1: Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module impact student performance?

It was hypothesized that the inclusion of the animated peer-like pedagogical agent in the module would improve student performance on the post-test to a larger degree than students in control group working without an agent. Some social-psychological theorists have proposed that there is a social component to learning, with some suggesting that learning with others or being aware of the presence of others working with them will improve performance (Hayashi, 2012). For example, Piaget (1995) noted working with peers of similar skill will "promote cognitive growth" (p. 572). Furthermore, several studies have indicated that including pedagogical agents in learning material can have a positive impact on learner performance (Atkinson, 2002; Haake & Gulz, 2009; van der Meij, 2013; Schroeder et al., 2013). Contrary to expectations, though, this hypothesis was rejected because the results did not indicate a statistically significant difference on the post-test measure between the treatment group and the control group. It may be that the agent's focus on motivational messaging and not on the delivery of content was not as effective for promoting learning in this environment and that more task-oriented instructions could have been included as well. When asked what they did not like about the program, a few individuals mentioned they would have liked to "have the text read" to them, including the participant who would "prefer being read the material when

working online, similar to lecture seminar approaches. Even having that option would help me focus better."

One respondent suggested there should be more feedback on the questions and that being told to "try harder next time" when getting a question wrong was "not very effective." When asked about working with the animated pedagogical agent, one participant noted that while not being opposed to it, Maddie's "role was encouragement, not teaching. If she was more of a teacher, that would have continued the interaction of the lesson...I would have rather her been more teaching or helpful tips to remember things." There may have been a mismatch between Maddie's function as a motivational agent and what would have benefited learners on this specific variable. As Park (2006) noted in his study, an agent which displayed seductive messages that were not relevant to the learning topic had no discernible impact on learning achievement. While Maddie's commentary does not necessarily fall into this category of delivering irrelevant messages, one participant did remark that the agent's comments about how she also struggled with the material and didn't understand it at first made the agent seem as if she was "trying too hard to relate to the students that might not understand the concepts" and that she "made the learning experience more drawn out for me." Other participants did remark that it would perhaps be better if she gave more content-based messages, such as when one participant replied that "if she explained the information in detail, it would be so much more effective." Another said, "I would have rather her been more teaching or helpful tips to remember things. If it is a lesson, I know I have to do it, so there isn't a ton of need for encouragement." Perhaps if Maddie had provided explicit task-oriented or directive instruction alongside her motivational messaging, it is possible that some

learners would have benefited in terms of their performance. This would be consistent with Baylor and the Pedagogical Agent Learning Systems (PALS) Research Group's 2003 study which concluded that "encouragement alone is not sufficient...for learning transfer" (p. 929) and that the agent should have expertise as well as motivational messaging.

Results indicated that both conditions saw a large increase in the mean of the post-test scores following the intervention; however, the significance of the increase in test scores cannot be attributed to the inclusion of the peer agent. Both versions of the online module were effective in increasing students' performance on the assessments measuring their ability to recognize and recall grammatical structures involving compound sentences and conjunctive adverbs. It may be the case that the cognitive skills being asked of the participants in the study were not very complex and relied on basic comprehension and recall, potentially making the module less challenging for most learners. Thus, a large increase in the post-test score for both conditions would not be surprising. It is interesting to note that while several studies do find that including a pedagogical agent does benefit student performance, it is not universal. Of particular importance to this study is Schroeder et al.'s (2013) meta-analysis of pedagogical agent studies which found that studies examining pedagogical agents in the STEM fields detected statistically significant changes in learner performance, but studies in the Humanities did not show significant results. This study follows that pattern.

It is also possible that the overall design principles upon which the modules were built were sufficient for learning to take place, which may be why participants responded well to both conditions of instruction. For example, a participant in the control group

wrote that she "[h]ad no problems applying the rules with the help of the examples and instructions." Both conditions were designed in accordance with Robert Gagné's theory on the Nine Events of Instruction (Gagné et al., 1992), which proposes that certain conditions must be met for learning to occur and that a particular sequence of events will lead to optimal learning. The first three events are gaining learner attention, presenting the learning objectives, and stimulating recall of prior learning, all of which occurred in both conditions. After the presentation of content (Event Four in Gagné's theory), a well-structured lesson will have learning guidance for the student on how to perform the task (Event Five), opportunities to practice the newly learned content (Event Six), and feedback on learner performance (Event Seven). Many of the positive comments in the open-ended response questions for both the treatment group and the control group specifically mentioned that they appreciated the examples that guided them and the multiple opportunities for immediate practice with feedback. For example, one participant in the control group "liked that it required me to do a few examples after the material was presented to make sure that I actually understood it." Some did say that they would have liked additional practice and feedback, but those elements were consistently positive features in both conditions. These types of examples, practice questions, and feedback did allow for some task-based messaging in both conditions.

Research Question 2: Effect on Self-Efficacy

RQ2: Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module improve student self-efficacy?

It was expected that there would be a statistically significant difference between the mean scores on the post-self-efficacy survey of the treatment group and the control group. Bandura (1977) proposed that learner beliefs in self-efficacy can be improved as learners interact with and observe others, and seeing others successfully perform a task will help a learner believe that they can also perform that task. Research indicates that agents expressing motivational messages can have a positive influence on student self-efficacy (Baylor et al., 2004; Baylor & Kim, 2005; Van der Meij, 2013; Huang & Mayer, 2016). According to situational leadership theory, learners who are able to perform a task but may be unwilling to do so or who may be insecure about their abilities would benefit from supportive, relationship-oriented approaches (Hersey & Blanchard, 1995) like those expressed by a peer-like pedagogical agent. However, the study did not find evidence to support this hypothesis, for the post-measure self-efficacy survey showed that the mean score for both groups was very similar. As part of the pre-measure, students were asked if they were already familiar with key aspects of the learning module (e.g., being able to name examples of conjunctive adverbs and to use semicolons to form compound sentences). One participant mentioned that she "already kinda knew about the topic, so I didn't need her to take more time explaining it." As Karumbaiah et al. (2017) found in their study of 6th grade math students, learners who already have a high level of skill may deem growth mindset messages to be irrelevant to them. Also, in the pre-measure, a significant number of students indicated they already knew many of the concepts associated with using conjunctive adverbs, even though the scores they earned on the pre-test did not reflect that they actually knew the material. It is possible that the self-reported scores on the pre-self-efficacy survey were a bit higher than the reality. Also,

while both the pre-self-efficacy measure and the post-self-efficacy measure did score quite high on reliability with a Cronbach's alpha (α) of .94 and .96, respectively, it should be noted that self-efficacy is a latent variable that cannot be precisely measured, which will leave this number open to some measurement error.

The data also show that opinions about Maddie were sharply divided. Some students did like having Maddie present in the module, saying that the "interpersonal" nature of the module made it "motivating, especially in a covid environment where students really don't get that experience." Another said that the "interactive parts of the module" helped her as a visual learner "to continually be engaged" and "helps me retain the content." Others said that they "enjoyed the virtual teacher," that "the virtual mentor concept was really cool" and "would be very good for someone who doesn't quite understand the material so they don't give up," or that Maddie's presence was good because her introducing the material "provided a close resemblance to actually being in a classroom with a teacher or professor" and that this environment "was more enjoyable than viewing the slides in complete silence." One person specifically singled out Maddie's motivational message "You're doing great!" and her "encouraging words" as something she liked about the module. Another participant indicated that "if [Maddie] wasn't walking me through the exercises, maybe I wouldn't have finished the assignment." For some students, the inclusion of the agent was obviously a positive, and these comments may suggest some support for the social-psychological idea that the presence of an audience as the learners are completing their task may have a positive motivational benefit, such as perceived self-efficacy, even if that result did not show up in a statistically significant way in the quantitative data (Lester et al., 1997; Hayashi,

2012). This is also supported in Huang and Mayer's (2016) qualitative data, which found that students who benefited from the peer-like agent's coping messages liked the encouragement the agent provided, while those who did not benefit from those same messages reported low anxiety or that they already knew the material being presented.

At the same time, though, some students expressed an opinion that Maddie was more of a distraction than she was a helper to them. One student noted that while she understood the appearance of the agent, he "could have done well without her" because she was "sort of annoying and creepy." Another thought that Maddie was "overly enthusiastic and trying too hard to relate to the students," but he also noted that while he didn't believe that he "would personally like to learn this way," it might be "a good technique for elementary school children or middle schoolers." Similarly, one thought Maddie was "a little childish" while still recognizing that "to make things engaging, it can't necessarily be 'adult.'" Maddie was designed to be an expressive agent showing a great deal of enthusiasm with the hope that learners would connect with her on a more personal or social level, even though she was an animated avatar. Veletsianos (2009) found that university students in an elementary education technology course who worked with an expressive agent achieved higher scores on a post-task exam than students working with a non-expressive agent; however, he also found that his agent received mixed reviews similar to Maddie's. For example, some learners did report that his agent was distracting and that if the agent's expressiveness had seemed more natural, the agent would have been less distracting (p. 352). Changes in Maddie's tone and expressiveness may make her appearance less distracting for some and improve her overall effectiveness in a future study. At the same time, Liew et al. (2013) had a peer-like agent who was

designed similarly to Maddie: a female college student in her 20s. In their study, the authors found that female learners were significantly less anxious working with an expert-like agent than they were working with a peer-like agent. In addition, female learners were significantly less anxious working with an expert-like agent than male participants were. A large majority of the population in this study was female, and this could have played some role in the results as well. Gender does not, however, always play a role in agent self-efficacy. Rosenberg-Kima et al. (2008) found that the age and "coolness" of the agent rather than the gender had a positive effect on self-efficacy, with young and "cool" pedagogical agents being more effective at increasing self-efficacy than "uncool" older agents.

Some students also discussed having more explicit instruction from the agent, with one participant saying that he felt "it's a great concept and could be great for students with a new way to present online" homework, but "at the moment, it kind of felt like she was just being a cheerleader for the students," and this "wasn't that helpful." One participant mentioned that "it didn't really feel like I was working with the instructor and felt more like someone was just watching me do homework...it didn't feel like there was any substance to what she was offering," and another pointed out that "the virtual instructor did not provide more information." Schroeder and Adesope (2013a) noted that "if the learner gets frustrated by the instructional monologue or the lack of interaction" with a peer-like agent, "it may lead to decreased engagement in the learning process" (p. 122). That may be the situation here, as Maddie did not provide actual instructor but only motivational messaging.

As noted in the section on student performance, it may also be the case that the fact that learners were performing a task that was not cognitively complex may have mitigated against Maddie's success at improving self-efficacy. It is possible that if participants were asked to complete a more complex topic, the motivational messages may have played more of a role. Several studies conducted in non-Humanities disciplines have demonstrated that the inclusion of peer-like pedagogical agents can have a positive impact on learner self-efficacy. For example, Baylor and Kim (2004) found that students in a computer literacy course who worked with a motivator agent exhibited higher self-efficacy than those working with an expert-like agent. They also found that students working with female agents reported higher self-efficacy scores than students working with male agents. Baylor et al. (2004), Huang and Mayer (2019), and Huang et al. (2020) found an increase in self-efficacy for students working with a motivator agent in a math environment. Maddie's motivational messaging may have worked better with a more complex subject.

Research Question 3: Effect on Student Attitude

RQ3: Does the inclusion of a peer-like, animated pedagogical agent in an online English composition module affect student attitudes towards grammar instruction?

For the third research question, it was assumed that learners would develop more positive attitudes towards their experience by working with a pedagogical agent who provided motivational messages. Path-goal theory would suggest that learners completing simple but repetitive tasks could benefit from supportive, motivational messaging (Chemers, 1984; Northouse, 2016). Social psychological theory proposed that, in addition to improved learning outcomes, working in the presence of others can

lead to greater motivational gains (Hayashi, 2012). The similarity-attraction hypothesis has suggested that people similar to ourselves can have an impact on our own feelings and attitudes (Kim, 2016). Thus, it would be expected that a peer-like agent who is similar to the majority of participants in a study would be able to positively influence participant attitude. In some prior studies, pedagogical agents have shown an ability to improve affective outcomes such as attitude, interest, and motivation (Plant et al., 2009; Arroyo et al., 2009; Kim, 2016; Liew et al., 2017). However, the attitude scale used in the study did not find any statistically significant results between the two conditions, and the hypothesis was rejected. As previously noted, while many students expressed an interest in working with Maddie and enjoyed having her in the module, there were also many students who did not. One participant wrote that Maddie "made me feel a lot more comfortable and reduced my stress a lot." Another described having a virtual agent as making her "feel more secure about the process" and said it was "comforting" and "definitely helpful" to have her presence there, but some others found her presence "a bit distracting" and felt that she slowed them down in the module. Furthermore, other learners noted that some of the visual elements of the agent's design were distracting, such as noticing that Maddie's teeth were visible when speaking, saying that Maddie was too enthusiastic, or describing her as having "disynchronous movements," and "odd" vocalizations. As Baylor and Kim (2005) described, in order for a pedagogical agent to be believable and effective, it is necessary that all five aspects of agent design—image, animation, affect, script, and voice—be working harmoniously (p. 3). For some learners, aspects of the agent's design may have hindered her effectiveness and her ability to positively influence learner attitude in the module.

In addition to the issues expressed by some participants in the treatment group regarding Maddie's persona, another possible reason for Hypothesis 3 not being met is that the control group was largely positive about working through the module, indicating that the design of the module itself was sufficient to influence their ratings on the attitude scale. For instance, participants in the control group described the module as being "short and sweet and to the point," "simple and direct," and designed in such a way to "work at my own pace." For students who felt that Maddie was slowing their progress or distracting them from the lesson, the motivational benefit would be negated. For the control group, it is also possible that the design of the lesson was sufficiently interactive and engaging without Maddie so that the control group received the benefit of a well-designed module without having a potentially distracting presence with them. It was interesting to see that one participant in the control group said that he "liked the subject matter" and "really enjoy learning about grammar rules." Another said that he "liked the overall concept" and thought that "it was nice to have a basic refresher on grammar rules." No participants in the treatment group expressed an explicit liking of grammar.

Research Question 4: Peer Persona

RQ4: How do learners perceive the peer-like pedagogical agent persona in an online English composition course?

The final research question looked at how the peer agent was perceived by the students in the online module. Some research has shown that people sometimes react to computer programs in the same way they would react to a human being (Norman, 1997; Veletsianos & Miller, 2008). On this measure, even with the deficiencies noted in the qualitative data, Maddie scored high on many items in the persona scale. Her highest

scores appeared on the Engaging sub-scale of the measure ($M = 4.21$, $SD = 0.60$), while her lowest scores were on the Facilitating Learning measure ($M = 3.58$, $SD = 0.89$) and the Credible measure ($M = 3.69$, $SD = 0.85$). This is not surprising since she was designed to be a motivating agent who could engage with the audience and was not intended as an expert imparting knowledge to the participants. Also, her lowest score on the scale was on "the agent's movement was natural" item ($M = 3.05$, $SD = 1.12$), suggesting the extent to which the design issue was an important factor influencing her effectiveness.

Given that Maddie's function was to be a motivating agent, it was surprising to see that her score on the item "the agent was motivating" only came in at a mean of 3.71. This was her lowest score in the Engaging subscale, and it was well below the next two lowest items on the subscale, "the agent was entertaining" ($M = 4.00$, $SD = 0.89$) and "the agent was expressive" ($M = 4.10$, $SD = 0.94$). This also suggests that the issues described in the qualitative data about Maddie being distracting or too enthusiastic played a role in driving down her effectiveness in the motivator role. In addition, a few students indicated they were already at least somewhat familiar with the subject beforehand, which would have made her messaging less effective on the motivation score and would have also brought down her score on Facilitating Learning.

On the peer persona scale, there were only four items on which Maddie fell below a 3.50 average score: the agent's movement was natural ($M = 3.05$, $SD = 1.12$), the agent led me to think more deeply about the presentation ($M = 3.10$, $SD = 1.22$), the agent helped me concentrate on the presentation ($M = 3.19$, $SD = 1.40$), and the agent improved my knowledge of the content ($M = 3.29$, $SD = 1.31$). The scores on these particular scale

items highlight two potentially important issues which may have decreased Maddie's effectiveness in the lesson: she did not do more to highlight areas of content and her presence was distracting to some of the learners.

Leaders in Higher Education

Educational leaders are often called upon to make decisions about how to incorporate and support the inclusion of research-verified best practices in the classroom. As educational leaders, we have a responsibility to continue to adapt our strategies and approaches to learning and to always consider new ways in which our online classes and programs can meet quality standards. The current study and previous research on pedagogical agents suggest that there are ways in which we can improve the overall user experience and quality of our online and distance courses. This is particularly important as we work to understand the expectations and methods of learning for each new generation of students who are making their way into institutions of higher education, and we must be on the lookout for strategies and methods that will appeal to learners who are increasingly savvy about using technology and who may have different learning needs than mainstream students.

The inclusion of animated pedagogical agents or other educational avatars may be one way in which we can make content more engaging for learners and help establish greater presence in an online environment. Several learners described how Maddie made the online environment seem like more of an actual class with connections and interaction, with one participant also describing how having the agent present had a positive impact because "her words of encouragement...prevented me from being too nervous to complete the task at hand." Even a participant who did not particularly like Maddie said that he "liked the idea of trying to find new ways to try to keep students

engaged with the technology." A well-designed pedagogical agent can add an interactive element that is often missing from online courses that are more statically designed or that are teacher-centered rather than learner-centered. The ability of the pedagogical agent to establish a presence in the classroom and to be seen as having a distinct persona may be able to help reduce the transactional distance that learners sometimes feel in an online environment, and students who feel less isolated will be more likely to complete the online course (Huang et al., 2016; Moore, 1993). A pedagogical agent who is designed in such a way that he or she can mimic instructor presence and have a positive social-psychological effect on learners, particularly in lower division courses where competency and self-efficacy will presumably be weaker, would be a valuable addition to online course design. The qualitative data suggests that pedagogical agents can serve this function, as with the participant who wrote that she "loved working with the virtual instructor much more [than a human instructor] because this instructor was nice, explained things thoroughly, was easy to understand, and I did not have to worry about what I looked liked during the module like I have to on Zoom." Another participant wrote that "the virtual peer and the human instructor are extremely comparable. They are both able to break down and simplify concepts and also provide some motivation through their own words." These results indicate that, in the absence of a human instructor, it is possible for an interactive pedagogical agent to establish a human-like connection with learners. Some studies have shown that pedagogical agents that have been operationalized as Expert or expert-like agents have shown positive results for outcomes like learning transfer (Atkinson, 2002; Baylor & Kim, 2004; Baylor & Kim, 2005).

There is no conclusive evidence that one agent persona is necessarily more effective at promoting one outcome over another (e.g., cognitive or affective).

By being more aware of the opportunities that pedagogical agents offer in online course design, leaders can advocate for positive change in their institutions. The world of online education is rapidly changing, and educational leaders must be open to many possibilities to adapt to those changes. These changes also present opportunities, however, as administrative leadership, instructional designers, and faculty members will have the opportunity to work in a collaborative fashion to design more interesting and unique content for their learners. Considering how pedagogical agents could be incorporated into online courses is just one avenue for this discussion.

Limitations

Some limitations in the study have been identified and will be presented below. In addition, the implications of the study and suggestions for future research will also be discussed.

One obvious methodological limitation of this study is that it was conducted at the height of the coronavirus pandemic in the United States, which forced data collection activities to be conducted exclusively in an online format via Zoom sessions. The restrictions placed on how research could be conducted may have played a part in dampening the participation rate in the study, resulting in a small sample size for the research. In addition, a fairly large percentage of the sample was excluded because of an error with the pre-test survey and the post-test survey that made it impossible to identify each response to a specific individual on those two metrics, making it necessary to

exclude those individuals for the experiment. A study with a larger sample size may have been able to deliver more reliable results.

Another methodological limitation of the study is that participant sample may not be sufficiently representative of the wider population. The large majority of the participants in the study were White females, and it is possible that this demographic breakdown may skew the results. Of the eleven learners who identified as "Other" or "non-white," only four were in the treatment group, and both non-native speakers of English were in the control group. It should also be noted that all survey respondents came from just one university, and it is possible that including participants from other institutions may provide different results. In future versions of the study, it would be beneficial to have a more representative sample that is more racially diverse and has a larger number of male respondents.

Another possible limitation of the study is the reliability of the post-test measure used to examine student performance. While the other survey measures came in at relatively high levels on Cronbach's alpha, the post-test score was more borderline at .71, potentially impacting its reliability. The instrument was not reliability-tested before the study, which may have had an impact on the final results. Similarly, the module was completed all at one time, so it is difficult to know how long the improvements in student knowledge of the lesson persisted after the module. It would have been useful to have tested the same students again several days or weeks after the module was over to see if the increases in student performance remained.

In addition to the reliability of the post-test measure, it is possible that there were other threats to internal or external validity in the research design. One potential threat is

that the pre-test which students completed may have introduced a testing bias and made participants more alert to what they were learning. This was controlled by having both groups take the pre-test and post-test (Mertens & Wilson, 2012). There may be a time bias involved as well, for the post-test measuring student performance was conducted immediately after the module. It is not known if participants retained the knowledge days or weeks later. Because the study took place over several weeks, it is also possible that students who participated in the study may have encouraged their friends or roommates to participate in order to receive the gift card incentive, and, in the process, they may have discussed the contents of the study.

In addition, the study would benefit from a re-designed agent that would be less distracting for students. Although many students liked working with the Maddie, her visual and auditory features were sufficiently bothersome to some students that her design limited her effectiveness as a motivating agent. Before the study began, there was no opportunity to test Maddie's design to see how college-level students would perceive her. It would have been useful to have had the opportunity to make adjustments to Maddie's dialogue before launching the study. Also, slightly re-working her tone and voice would be beneficial for those learners who felt as though Maddie was addressing an audience significantly younger than themselves. In future versions of the study, it may also be possible to give students the option of skipping Maddie's speeches if they choose to do so. A question could be added to one of the post-test surveys that would ask students if they skipped any or all of Maddie's messages and would ask why they chose to skip them. It could even be possible to allow students to choose whether they work with an animated agent at all.

A final limitation would be that the sample was collected in the latter half of the Spring 2021 semester, meaning there may be a difference in the target learner population compared to conducting the study at the beginning of the semester. By the end of the semester, students who are not doing well in their courses begin to stop attending classes and stop responding to e-mails, possibly leading to selection bias among the respondents. It is possible that this difference may have a small but noticeable impact on such items as the overall self-efficacy and attitude displayed by the survey respondents.

Suggestions for Future Research

Further research is needed to determine ways in which an animated pedagogical agent could be used more effectively in an online college-level English course. While the quantitative data did not provide any evidence of a significance benefits to the inclusion of an agent, the qualitative data suggest there is the potential to achieve more significant results in future studies.

Future research involving college-age students could be conducted with a re-designed peer-like agent to see if a less distracting agent would yield better results. Further, future research may experiment with including a male agent instead of a female agent. Arroyo et al. (2009) found that female university students saw gains in learning, attitudes, and motivation when working with a male agent versus a female agent. When studying ninth graders, Kim (2016) saw that girls working with a male peer demonstrated an increase in positive attitude towards the subject being studied and that they showed similar attitude gains when working with an expert female agent when compared to working with a female peer. Given that the participant sample in this study skewed heavily young and female, it may be beneficial to experiment with a male agent to see if

the same results can be found. Similarly, it would be possible to include an agent of a different ethnicity or persona to see if statistically significant results could be achieved.

Also, it may be beneficial for the study to take place with a more complex topic, one which required learners to work in a higher cognitive domain and one which might prove more fruitful for motivational messages. In addition, further studies could include the use of an expert-like pedagogical agent, since several participants did make comments indicating that more instruction and less motivating messages from the agent would have been useful to them.

Conclusion

This study examined the inclusion of a peer-like, animated pedagogical agent in an online self-paced English learning environment to see if student outcomes, including performance, self-efficacy, and attitudes, could be improved. Based on the results from this study, no statistically significant difference between the treatment group and the control group was found on performance. Both conditions did see an increase in their performance from the pre-test to the post-test, indicating that the design of the module was effective in promoting student learning. The study also found that there was no statistically significant difference between the treatment group and the control group on self-efficacy. Again, both conditions draw an improvement in their self-efficacy scores from the pre-self-efficacy measure to the post-self-efficacy measure. The study detected no statistically significant difference between the treatment group and the control group on attitude towards grammar instruction. Participants in the treatment group did perceive the agent as having a distinct persona.

At the same time, it is still possible that the inclusion of an animated pedagogical agent in an online environment would be beneficial for many students. Although the quantitative data uncovered in this study did not find a statistically significant benefit between the treatment group and the control group in this study, the qualitative data collected indicated the pedagogical agent did have a positive impact for some. Further exploration may find that a pedagogical agent that is designed in a more effective way visually and verbally may have greater success in this field. Additional research using other types of agents and utilizing a study with a greater sample size would further our knowledge of the field and would lead to a greater understanding of how to design effective online courses.

While the results of the study did not indicate a significant improvement on student performance, self-efficacy, or attitude as a result of including a peer-like, animated pedagogical agent, it did contribute to the field by examining pedagogical agents in Humanities classes, which is an area that is not well-developed in the literature when compared to STEM fields. The qualitative data gathered from the study also contributes to our knowledge of what can make an animated pedagogical agent effective or ineffective for college-age learners, as well as demonstrating that a well-designed lesson following educational best practices (e.g., Gagné's Nine Events of Instruction) can positively influence learning outcomes.

As online learning continues to grow in the United States, it will be increasingly important to focus on elements of course design that can have the most positive impact for learners across the disciplines. Animated pedagogical agents may well be a part of that future.

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APPENDICES

Appendix A: Demographic Survey

1. Your age: _____
2. Gender:
 - Male
 - Female
3. Major: _____
4. Ethnicity
 - Caucasian
 - African-American
 - Hispanic-Latino
 - Asian
 - Other
 - Please specify: _____
5. What is your current class level (e.g., Freshman, Sophomore, Junior, or Senior)?
6. How many years have you attended?
 - Less than one year
 - 1-2 years
 - 3-4 years
 - 5+ years
7. Is English your native language?
 - Yes
 - No
8. Do you currently work a full-time job?
 - Yes
 - No
9. Have you taken a fully online course before?
 - Yes
 - No
10. Have you learned grammar rules for using conjunctive adverbs before?
 - Yes
 - No
11. What was your score on the English section of the ACT: _____
12. How would you rate your English grammar skills?
 - Very Poor
 - Poor
 - Average
 - Good
 - Very Good

Appendix B: Pre-Test and Post-Test

Directions. Read each statement below carefully and indicate whether that statement is True (T) or False (F)

1. I can explain the characteristics of an independent clause. _____
2. I can explain the difference between a dependent clause and an independent clause.

3. I can name at least three conjunctive adverbs. _____
4. I know how to use semicolons to form compound sentences with a conjunctive adverb. _____

Directions: Read the sentences below and combine the simple sentences into compound sentences using an appropriate conjunctive adverbs.

1. It began to snow. The roads became very dangerous.

2. I wanted to get a degree in Chemistry. My parents wanted me to go to law school.

3. I had to work late last night. I still had enough time to write my research paper.

4. Learning French is difficult for me for several reasons. I'm not very good at the pronunciation.

5. Students must pay their tuition on time. They may be dropped from their classes.

Directions: In the space provided below, write three compound sentences using a conjunctive adverb. Each conjunctive adverb you use can only be used once.

1.

2.

3.

Appendix C: Self-Efficacy Measure

Directions: On a scale from 0 (cannot do at all) to 10 (highly certain can do), please rate how certain you are that you can effectively perform each of the skills below.

Skills	Your confidence (0-10)
1. State the rules for using conjunctive adverbs in sentences when writing	
2. Identify dependent clauses	
3. Identify independent clauses	
4. Distinguish between dependent clauses and independent clauses	
5. Identify conjunctive adverbs	
6. Define compound sentences	
7. Use commas correctly when writing compound sentences with conjunctive adverbs	
8. Use semicolons correctly when writing compound sentences with conjunctive adverbs	
9. Combine simple sentences into a compound sentence using an appropriate conjunctive adverb	
10. Compose a compound sentence using an appropriate conjunctive adverb.	

Appendix D: Student Attitude Survey

Please respond to this survey about the *Improving Your Grammar Skills: Conjunctive Adverbs* module you just completed. Circle your answer for each statement based on the following key:

- 5 – strongly agree
- 4 – disagree
- 3 – neutral
- 2 – agree
- 1 – strongly disagree

Motivation					
1. I liked studying the grammar rules in this module	5	4	3	2	1
2. Studying the grammar rules in this program was more interesting than studying them in a typical English course.	5	4	3	2	1
3. Learning proper grammar rules for conjunctive adverbs is valuable for making me a better academic writer.	5	4	3	2	1
4. Incorporating correct grammar rules into my writing will make my writing more interesting.	5	4	3	2	1
Perceived Difficulty					
5. It was easy to learn from this program.	5	4	3	2	1
6. I had a hard time understanding how to apply the grammar rules learned in this module.	5	4	3	2	1
7. I had to work hard to learn the grammar rules presented in this module.	5	4	3	2	1
Perceived Effort					
8. I did my best to learn the grammar rules presented in this module.	5	4	3	2	1
9. I carefully studied the explanations and examples.	5	4	3	2	1
10. I was able to remain completely focused on the material during the entire module.	5	4	3	2	1

Open-Ended Questions for those in the treatment condition.

Please respond to the following questions about your experience working with a pedagogical agent.

1. What did you like best about the module? Please explain in a few sentences.
2. What did you like least about the module? Please explain in a few sentences.
3. What effect did working with a virtual peer have on your perception of this module? Please explain in a few sentences.
4. Compared to working with a human instructor, how helpful was working with your virtual instructor? Please explain in a few sentences.

Open-Ended Questions for those in the control condition.

Please respond to the following questions about your experience working with a pedagogical agent.

1. What did you like best about the module? Please explain in a few sentences.
2. What did you like least about the module? Please explain in a few sentences.
3. Compared to working with a human instructor, how helpful was working with a self-paced, computer based module? Please explain in a few sentences.

Appendix E: Agent Persona Scale

Please respond to this survey about the virtual agent included in the module you just completed. Circle your answer for each statement based on the following key:

- 5 – strongly agree
- 4 – disagree
- 3 – neutral
- 2 – agree
- 1 – strongly disagree

Facilitating Learning

- The agent led me to think more deeply about the presentation.
- The agent made the instruction interesting.
- The agent encouraged me to reflect what I was learning.
- The agent kept my attention.
- The agent presented the material effectively.
- The agent helped me concentrate on the presentation.
- The agent focused me on the relevant information.
- The agent improved my knowledge of the content.
- The agent was interesting.
- The agent was enjoyable.

Credible

- The agent was knowledgeable.
- The agent was intelligent.
- The agent was useful.
- The agent was helpful.
- The agent was peer-like.

Human-like

- The agent has a personality.
- The agent's emotion was natural.
- The agent was human-like.
- The agent's movement was natural.
- The agent showed emotion.

Engaging

- The agent was expressive.
- The agent was enthusiastic.
- The agent was entertaining.
- The agent was motivating.
- The agent was friendly.

Appendix F: IRB Approval Form



INSTITUTIONAL REVIEW BOARD
OFFICE OF RESEARCH INTEGRITY

DATE: December 4, 2020

TO: Justin Mathews, EdD
FROM: Western Kentucky University (WKU) IRB

PROJECT TITLE: [1655014-1] THE EFFECTS OF PEDAGOGICAL AGENT PERSONA ON LEARNING AND SELF-EFFICACY IN ADULT LEARNERS IN AN ONLINE ENVIRONMENT

REFERENCE #: IRB 21-084
SUBMISSION TYPE: New Project

ACTION: APPROVED
APPROVAL DATE: December 4, 2020
EXPIRATION DATE: April 1, 2021
REVIEW TYPE: Expedited Review

Thank you for your submission of New Project materials for this project. The Western Kentucky University (WKU) IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the project and insurance of participant understanding followed by an *implied* consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

This project has been determined to be a MINIMAL RISK project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of April 1, 2021.

Please note that all research records must be retained for a minimum of three years after the completion of the project.

If you have any questions, please contact Robin Pyles at (270) 745-3360 or irb@wku.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Western Kentucky University (WKU) IRB's records.

Appendix G: Implied Consent Document



IMPLIED CONSENT DOCUMENT

Project Title: The Effects of Pedagogical Agent Persona on Learning and Self-Efficacy in Adult Learners in an Online Environment

Investigator: Justin Mathews, English Department, mathejl@wku.edu

You are being asked to participate in a project conducted through Western Kentucky University. The University requires that you give your agreement to participate in this project.

You must be 18 years old or older to participate in this research study.

A basic explanation of the project is written below. Please read this explanation and email the researcher any questions you may have. If you then decide to participate in the project, please continue to the tasks. You should keep a copy of this form for your records.

- Nature and Purpose of the Project:** This research project is examining how technology-enhanced strategies may positively impact student learning, attitude, and self-efficacy.
- Explanation of Procedures:** You are being asked to complete an online English grammar module that will take you approximately one hour to complete. During the learning process, you will be completing a few short surveys, exercises and tests, and the time you spend on the tasks will be recorded.
- Discomfort and Risks:** There are no known or anticipated risks to the participants in this study.
- Benefits:** The results from the research will inform the researchers of the potential benefits that technology-enhanced strategies may have for improving online language instruction. This information could help improve the quality of online education. Participating students will also receive extra credit for their course or will receive a \$12.00 Amazon gift card.
- Confidentiality:** All information is confidential to guarantee your privacy. The initial data will be stored on WKU Blackboard, which is password-protected. The data will then be downloaded to the Principle Investigator's computer, which is also password-protected. Identifiable information such as your name will be removed during the data analysis phase. No one will be able to identify you or your answers as aggregate data will be reported. All of the raw data will be secured in an encrypted, password protected computer file. Records will be viewed, stored, and maintained in private, secure files only accessible to the primary investigator. After three years time, the information will be destroyed.
- Refusal/Withdrawal:** Refusal to participate in this study will have no effect on any future services you may be entitled to from the University. Anyone who agrees to participate in this study is free to withdraw from the study at any time with no penalty.

You understand also that it is not possible to identify all potential risks in an experimental procedure, and you believe that reasonable safeguards have been taken to minimize both the known and potential but unknown risks.

Your continued cooperation with the following research implies your consent and indicates that:

- You have read the above information
- You voluntarily agree to participate
- You are 18 years of age or older
- You agree to participate in a recorded Zoom session

THE DATED APPROVAL ON THIS CONSENT FORM INDICATES THAT
THIS PROJECT HAS BEEN REVIEWED AND APPROVED BY
THE WESTERN KENTUCKY UNIVERSITY INSTITUTIONAL REVIEW BOARD
Robin Pyles, Human Protections Administrator
TELEPHONE: (270) 745-3360

WKU IRB# 21-084
Approved: 3/17/2021
End Date: 6/01/2021
EXPEDITED
Original: 12/04/2020